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The Manufacture of Glass Milk Bottles

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(*Written for* THE GLASS INDUSTRY)

Glass of a crude type was known and employed in the arts at a very early date but no reliable information is available as to its production earlier than 1400 B. C. Remains of furnaces and workshops found by Petrie at Tel-el-Amarna show that manufacturing was confined to glass rods and beads and small vases which were formed by dipping a clay core into molten glass.

Glass did not become an article of domestic and industrial use until the time of the Roman Empire. Roman glass was almost invariably of soda-lime type and high in silica content. The manufacture of glass in England began in 1230, where it was established on the border of Sussex and Surrey.

The manufacture of glass milk bottles is a very interesting chemical problem. It is an industry which requires a well-trained chemist, a chemist who knows both the theoretical and practical side of glass making. Above all he must know what to do when the glass goes "bad." (I say this because I have seen the rule-of-thumb method used so many times and with such disastrous results).

One of the first considerations in making glass for milk bottles is raw materials. The glass used in such ware should be of a certain color; this color is just a faint tint of pink which gives a richer appearance to the milk. Should there be too much color in the bottle the milk will look bloody, especially if there are any streaks. On the other hand, should the color be too low, and of course by low is meant green, the milk will look weak and thin. Therefore, pains must be taken to make the glass of just the right color, free from seeds and from all other defects.

The following materials enter into the making of glass for milk bottles:

SAND.—The chief ingredient of glass is sand. The kind and quality of sand is of the utmost importance, as the color, brilliancy, transparency and other physical properties of the glass depend upon it. The requisites of a good glass sand are:

1. It must analyze at least 99% pure silica (SiO_2).
2. Sand must be perfectly dry in order to mix well with the other chemicals.
3. Sand must be uniform in size and the grains small. Grains should pass through a ten-mesh sieve.
4. The grains of sand should not be too coarse to prevent reaction with the other materials, nor yet too fine so as to cause reaction to take place too violently and cause excessive foaming in the tank during melting.
5. The impurities in sand must be very low.

The chief impurities in sand are iron, aluminum and organic matter and possibly titanium. The presence of a small amount of alumina does not injure the glass, but iron acts as a coloring agent, producing a green of more or less intensity when in the ferrous state and a yellow color when in the ferric condition. It is not definitely known as yet whether titanium affects the glass or not. Some glass men believe that it gives the glass a peculiar color while others claim that it makes the glass brilliant.

6. The higher the per cent of silica in the sand the harder, more difficultly fusible and more brittle the glass becomes.

SODA-ASH.—The next important chemical used in glass making is soda-ash. This is very constant in chemical properties and usually contains over 98% sodium carbonate and only a very minute amount of iron. This alkali makes the glass softer, more fusible, but less capable of resisting atmospheric changes and chemical reagents. It combines with the silica and forms sodium silicate.

ALKALI EARTH.—The principal source of alkali earth is lime. It is introduced as a carbonate, oxide or hydrated oxide. Burnt lime is sometimes used. The advantages of the different forms of lime is an open question, some plants preferring one form, some another. The advantage of using burnt lime is the saving in heat by the removal of carbon dioxide before entering the tank. On the other hand the setting free of the carbon dioxide from the carbonate helps stir the glass during the process of melting. Lime must be nearly iron free and must not contain too much magnesia, as this makes the glass hard and more difficult to plane. In-

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creasing the percentage of lime decreases the fusibility and renders the glass harder but not so brittle as in the case of a high silica content.

DECOLORIZERS.—There are several decolorizers used in glass making to-day, but the two most important ones are manganese in the form of manganese dioxide and metallic selenium or selenium dioxide. Decolorizers in which some form of selenium is mixed with sand, soda-ash, arsenic and powdered blue are also used.

MANGANESE.—This is used to correct the color effect of the iron in the chemicals used for glass making, and it also acts as an oxidizing agent. The amount of manganese introduced into the batch varies greatly. The writer has seen a jump from sixteen to twenty-four pounds per ton of sand in a very short period of time. The amount used depends upon:

(a) Amount of iron present in raw materials. The more iron present the more manganese there will be required.

(b) The quality of cullet or broken glass used. If the cullet contains any appreciable amount of glass that has been decolorized by selenium, more manganese is required. The manganese and selenium will not work together, and a dirty looking yellowish-green color is produced. The amount of manganese also depends upon whether the cullet is low or high in color. Obviously if cullet is high in color less manganese is required, and if low in color, more manganese is required. The best kind of cullet to use is white flint.

(c) The kind of fire carried upon the tank has a great bearing upon the amount of manganese to use. The flame must not be too sharp as it will burn out the color and, on the other hand, the temperature must not be too low or the color will be too high. A nearly neutral flame must be maintained to successfully use manganese. Manganese also loses its color when it is reduced. The most common reducing agents are a smoky flame and organic matter such as dirt and grease. For this reason if we use dirty cullet it requires more manganese to give the required color.

(d) By using a small amount of niter less manganese will be needed, as the niter is a strong oxidizing agent and counteracts the reducing action.

(e) The mixing of batch. Here is another place where the quantity of manganese may vary. The batch must be thoroughly mixed to obtain uniform distribution of manganese.

(f) The condition of the tank may also have some bearing upon the amount of manganese used. This point has never been explained, as far as I know, but it has been shown that the older the tank the more manganese is usually required.

(g) The amount of manganese required depends on the amount of "pull" upon the tank. When more glass is taken out in a given time, less manganese will be required, since the glass has been in the tank a shorter time and the color has not had a chance to burn out. Conversely, where the pull is light more manganese will be needed as the glass is in the tank longer.

SELENIUM.—At the present time many prefer selenium to manganese. It is added as metallic selenium or in the form of some prepared decolorizer. The advantages of selenium over manganese are:

(a) The color does not burn out. One of the greatest troubles with manganese is the usual dip of low color over Sunday when the glass is allowed to cool. When early Monday morning the glass is again brought up to heat, the manganese color is usually burned out in the nose. Not so, however, with selenium. The same temperature can be maintained at all times and there will be no difference in color.

(b) Only small amounts are used.

(c) The color is just as good if not better than that obtained by manganese.

(d) The cost of using selenium is less than manganese.

(e) Selenium overcomes the great annoyances and difficulties due to the fugitive character of manganese color.

ARSENIC.—Arsenic is another chemical used in glass making and is introduced in the form of white arsenic (arsenious acid, As_2O_3). Great care must be used in handling it, as it is very poisonous and on some workmen produces burns and sores. It is always used when selenium is used as the decolorizer. Arsenic itself does not exert a coloring effect on the glass and only small amounts are retained in the glass because of its volatile nature. Arsenic acts as a carrier of oxygen and its presence tends to facilitate the oxidation of impurities contained in the glass. Arsenic also seems to impart brilliancy to glass.

BLUE.—Some firms use a powdered blue which contains cobalt oxide together with powdered glass, while others use cobalt oxide. Powdered blue contains about 5% cobalt oxide. With soda glass more cobalt is necessary. The violet color imparted by manganese is complementary to the green shade caused by the iron and serves to decolorize the glass by causing a more uniform absorption of all the wave-lengths of the spectrum. Since manganese alone fails to absorb sufficient yellow the blue of cobalt is required to complete the decolorization. The using of cobalt may be likened unto the use of bluing in the washing of clothes.

CULLET.—The cullet used in glass making should be very clean. Cullet causes the batch ingredients to react on each other at a lower temperature than they would if melted together without it, in fact cullet serves as a flux. At the temperature necessary to produce action between the silica and the other constituents of the glass, the alkali is volatile and much is lost before it reacts with the silica, but the cullet accelerates the melting and dissolving of both alkali and silica, thus promoting their inter-action.

OPERATIONS IN THE MANUFACTURE OF MILK BOTTLES

The main operations are the following:

1. UNLOADING OF RAW MATERIALS. This may be done either by hand labor or by machinery.

2. STORING OF RAW MATERIALS. Materials should be stored as near to the batch room as possible so as to be convenient for batch-mixers. The material is usually placed in bins capable of holding several carloads.

3. MIXING. This is of the utmost importance and upon it depends the color and quality of glass obtained after melting. Mixing is done at some plants by workmen turning the batch over several times in order to insure complete and uniform incorporation of all ingredients. Usually, however, a mechanical device is used. A convenient form of mixer consists of a hollow drum with blades disposed like the floats of

a paddle, revolving in a box of which the lower half has a cylindrical section. It has been suggested to mix in a wet condition and then use some of the wasted heat from the tank for drying. When hand mixing is used the procedure is as follows: Sand, soda ash and lime are weighed by the batch mixer on large platform scales. The other chemicals are best handled by the chemist or some one who knows the importance of proper and exact weighing. The manganese, niter and powdered blue are weighed separately and then intimately mixed.

The correct amount of sand is first put upon the floor and heaped up in a long pile. On top of the sand one-half of the lime is placed. The soda ash is next put on and the whole mass is rounded up into shape and the coloring, niter and blue sprinkled thoroughly over it. The other half of the lime is then added and the pile is then ready to be turned. The pile is turned over at least three times and when completed it should have a homogenous appearance and should not show sand or any other material in excess at any point. The amounts of raw materials used for making the batch vary to a slight extent in different plants. The following is a typical formula for making glass for milk bottles.

Sand	2,000 pounds
Soda-Ash	750 pounds
Lime	250 pounds
Niter	21 pounds
Powdered Blue	2 ounces
Manganese (average 16 lbs.)	12-35 pounds

When a decolorizer is used the niter is omitted and 4 to 5 lbs. arsenic is used together with 24 to 36 oz. of decolorizer, depending upon selenium content. Based upon the selenium the amount varies from ½ to 2 oz. per ton of sand. If the decolorizer contains powdered blue the blue is omitted from the above formula.

4. FEEDING TANK WITH BATCH. The approximate proportion of batch and cullet to use is two of batch to one of cullet. The usual rate of feeding the tank is three wheelbarrow loads of batch to two loads of cullet on the hour and four loads of batch to two of cullet on the half hour. This, however, depends upon the rate of pull on the working end and must be governed accordingly. When the batch and cullet is put into the tank the first time it is pushed to the right side of the tank and the next time to the left side. It is never pushed directly into the middle of the tank, as it has a longer time to melt if pushed to the sides.

5. MELTING. The temperature used in melting is around 2100° F. This temperature is regulated by means of pyrometers, chiefly of the thermo-electric type. Temperature plays a very important role in glass making. If using manganese it is extremely necessary to maintain a constant temperature, for two reasons: First, if the temperature is too high the manganese will burn out, and second, if glass is not hot enough there will be a lot of seeds and high color at the working end which will show in the finished product.

When using manganese some glass men think it essential to take proofs of the glass at the doghouse every hour. The writer thinks this is not necessary at all, as there are so many variations in the color of doghouse proofs that they mean little. At one time, for example, a green proof may be obtained, and in the next hour we may get a red one. Doghouse proofs do, however, give one the temperature and feel of the glass and an experienced man can tell whether its condition is right or not by this method. The best and safest way to get glass of good color is to judge by the glass coming out of the tank and when changes are needed make them cautiously.

The color of proofs at the doghouse, in order to obtain the desired tint in the finished bottle, must be a strong pink, as this color will become weaker as it goes through the tank, due to the burning out of the manganese. These proofs are taken on the end of a steel rod which is dipped about eight inches into the glass and then allowed to cool.

After cooling the proof is compared with standard proofs. The appearance of the glass as it is melting is also of some importance to the glass maker. There should be only a small amount of scum and it should be clear near the throat. There should not be too many balls in the tank and melting should appear as going on evenly.

5. WORKING END AND GATHERING.—After the glass goes through the throat from the melting end into the working end it has a smooth and even appearance. It must be very hot in order to work well but it must not be too hot. The glass is all planed up now and is free from air bubbles and is ready for working. The glass is gathered on the end of a punty by revolving it rapidly in the molten glass. It is quite necessary to obtain approximately the right weight of glass upon the punty. The molten glass is then dropped into a blank and cut off by shears. The blank is then formed by means of compressed air, then lifted out mechanically and transferred to another mold where the finished bottle is blown. When the glass has become firm the plunger is withdrawn and the bottles are transferred to the annealing furnace. The molds are made of cast iron and so constructed that the pressed article can easily be removed. The temperature of the mold and plunger is regulated by streams of air blown against them, the expansion and contraction of the mold being carefully controlled by the workman. The plunger is operated by compressed air. In forming the blank the top of the bottle is formed together with the cap seat. This blank is then transferred to the mold proper and while the glass is still hot is blown into bottle form.

The latest advances in bottle machines do away with all labor. The glass flows from a melting tank into one which, revolving, carries the molten glass to the machine. The machine sucks up enough glass to make the bottle and at the same time forms the neck. It is then carried to the mold in which it is blown to its final shape. A good gatherer working upon quarts will produce around 300 dozen of packed bottles in 8 hours. On pints one will average 360 dozen and on one-half pints, 450 dozen.

6. SORTING AND PACKING.—As the bottles come off the lehrs they are weighed by girls. Bottles must neither be too light nor too heavy as the capacity of the bottles depends upon accurate size and weight. The following table shows the variations in weights that are permitted:

Size	Light Side	Standard Weight	Heavy Side
¼ pints	6⅞ oz.	7 oz.	7⅛ oz.
½ pints	9⅞ oz.	10 oz.	10⅛ oz.
Pints	14⅞ oz.	15 oz.	15⅛ oz.
Quarts	25¼ oz.	25½ oz.	25¾ oz.
½ gallons	32½ oz.	33 oz.	33⅛ oz.

If a bottle is too heavy it will be under-standard in capacity and if too light it will be over the standard.

Besides being inspected for weight the bottles are also examined for defects. Some of these defects are:

Out of round bottles, where the bottles feel flat if whirled between the fingers.

Stony, containing undissolved portions of batch or small amounts of fire-clay from the walls of the pot or tank.

Cordy or wavy, having threads of more or less sharpness running through them.

Seeds, containing small bubbles of unexpelled gases.

Not blown up.—When lettering and shape itself is incompletely blown up.

Check rings.—Little cracks in the ring of the top of the bottle.

There are numerous other defects to be watched for and bottles must be inspected very closely.

The bottles after inspection are packed in crates holding one-half gross each and are shipped in box-cars. Sometimes a car may be packed with uncrated bottles. This is called bulk packing.

Three other departments of a glass house making milk bottles are very important. One is the mold department, where the molds are made from rough castings by expert machinists, and where the lettering, name-plates, designs and other trade-marks are cut into the cast iron by letter cutters.

The second department is the graduation of the capacity of the milk bottles. The chemist generally does this work and it is accomplished by weighing bottles and obtaining several of standard weight and then filling them with water or better still, with milk, and determining whether they hold the required amount of liquid. The inspector must co-operate with the mold room and if the bottles do not hold enough or hold too much the molds must be taken off and repaired. This graduation is important as most cities have laws governing the capacity of milk containers and bottles not accepted by their inspectors will be rejected, with resultant loss to the factory.

The third department is the making of producer gas for fuel, as is frequently necessary. Here again the chemist must play an important role. He must obtain for his company the best grade of coal for making gas. He should analyze every carload of coal and find whether it is up to specifications. He must, of course, analyze from time to time the producer gas itself. This will show the efficiency of the gas produced and the knowledge will aid in the operation of the tank. He should also analyze the flue gases from the tank and also from the lehr. By means of these tests and the saving effected of fuel alone he will in most instances be able to repay the management many times over the amount of his salary.

In concluding it may be well to mention a few advantages of the glass milk bottle over any other kind of container for milk.

1—The milk can be seen and its condition and quality is fairly well revealed in a glass milk container; it cannot be seen in pasteboard.

2—The glass milk bottle is easy to clean.

3—Glass is just as cheap as any other kind of container.

4—Glass is durable.

5—Glass is not affected by atmospheric conditions, as rain, snow, heat or cold.

Variation of Electrical Resistance of Glass With Temperature*

The following table gives the values of a, b, and c in the equation

$$\log R = a + bt + ct^2$$

where R is the specific resistance expressed in ohms, that is, the resistance in ohms per centimeter of a rod one square centimeter in cross section.†

No.	Kind of glass	Density	a	b	c	Range of temp. Centigrade.
1	Test-tube glass.....	—	13.86	—.044	.000065	0°-250°
2	Test-tube glass.....	2.458	14.24	—.055	.0001	37-131
3	Bohemian glass.....	2.43	16.21	—.043	.0000394	60-174
4	Lime glass (Japanese manufacture)	2.55	13.14	—.031	—.000021	10-85
5	Lime glass (Japanese manufacture)	2.499	14.002	—.025	—.00006	35-95
6	Soda-lime glass (French flask)...	2.533	14.58	—.049	.000075	45-120
7	Potash-soda lime glass	2.58	16.34	—.0425	—.0000364	66-193
8	Arsenic enamel flint glass	3.07	18.17	—.055	—.000088	105-135
9	Flint glass (Thomson's electrometer jar)	3.172	18.021	—.036	—.0000091	100-200

COMPOSITION OF SOME OF THE ABOVE SPECIMENS OF GLASS

Number of specimen =	3	4	5	7	8	9
Silica	61.3	57.2	70.05	75.65	54.2	55.18
Potash	22.9	21.1	1.44	7.92	10.5	13.28
Soda	Lime, etc.	Lime, etc.	14.32	6.92	7.0	—
Lead oxide.....	by diff.	by diff.	2.70	—	23.9	31.01
Lime	15.8	16.7	10.33	8.48	0.3	0.35
Magnesia	—	—	—	0.36	0.2	0.06
Arsenic oxide....	—	—	—	—	3.5	—
Alumina, iron oxide, etc.....	—	—	1.45	0.70	0.4	0.67

TEMPERATURE RESISTANCE COEFFICIENTS OF GLASS

Temperature ...	450°	500°	575°	600°	700°	750°	800°	900°	1,000°
Glass	—32.	—6.	—1.5	—8.	—0.17	—0.1	—0.06	..	..

*Smithsonian Physical Tables, 1920.
†T. Gray, "Phil. Mag." 1880, and "Proc. Roy. Soc." 1882.

Zirconium

An investigation into the properties, preparation and possible uses of the so-called "mystery" metal, zirconium, and its salts has been made by the United States Bureau of Mines. Zirconium oxide has frequently been recommended as an abrasive, a refractory and an agent for making enamel ware opaque. It has been used for polishing powders. Zirconium carbide is suggested as a substitute for diamonds in cutting glass. Zircite fire-brick are used for furnace lining and in other places where a low coefficient of expansion, high melting point, and maximum resistance to slag corrosion is demanded.

The Development of Various Types of Glass*

The Effect of the Joint Presence of Sodium and Potassium on the Solubility of Lead Glasses

By C. J. PEDDLE, D.Sc., F.I.C.†

One of the most important properties demanded of all commercial glasses is that of high durability. The user expects glass to "weather" well, preserving its polished surface unaltered through long exposure in ordinary conditions of use. A useful and rapid test of the durability of a glass is to investigate its solubility (or, more correctly, the degree to which the more soluble constituents can be extracted) in powdered form in boiling water, and so the solubility of glass becomes a highly important consideration.

A prolonged study of the solubility of glass in water has led to the definite conclusion that solubility is dependent chiefly upon the amount of alkali in the glass. The reduction of alkali in a batch always results in a reduction of the solubility value and an improvement in the durability of the glass. The diminution of the amount of alkali in a glass batch, however, always raises the melting temperature, so that the manufacturer cannot go below a certain limit or it would be impossible to melt his glass with the furnace temperature at his disposal.

Recent research by the author has shown that, without lowering the amount of alkali (that is to say, without impairing to any great extent its melting properties), it is possible to improve the durability of any commercial glass. This is accomplished by using both sodium and potassium compounds as fluxes in the same batch, instead of the same percentage amount of either alkali alone.

The author first discovered this important fact when working on alkali-calcium-silicate batches for hard crown optical glass in 1916,[1] and found it was also true for lead, barium, strontium, zinc, and magnesium glasses. He was surprised to find that literature on glass was singularly devoid of information on this phenomenon. One definite reference is made by Stoermer[2] who states that he improved the durability of a certain window glass by substituting potassium carbonate for some of the sodium sulphate in the original batch, the percentage of silica and lime remaining substantially the same. In discussion of the phenomenon, the author found that the fact had been noted in isolated instances in manufacture. Thus Dr. Travers informed him that he had found this state of affairs to hold in the manufacture of glass for lamp-working, and Professor Turner also stated that in the investigation of lead glass for table ware at Sheffield they found a mixture of alkalies gave more durable glass. The results obtained at Sheffield have since been published[3]. Since information on so highly important a matter was so meagre, and where available only applied to isolated glasses, it seemed well worth investigating whether the phenomenon held throughout widely differing types of glass. Some of the author's results obtained during this investigation have already appeared[4] and can be summarized as under:—

In the alkali—RO—SiO_2 *glasses, where* RO *is the oxide of either calcium or lead, when the total alkali present is less than* 20 *per cent., the glass containing both alkalies in equal proportion by weight will be less soluble and more durable than either the glass containing all its alkali as potassium oxide or all its alkali as sodium oxide. This is true whatever the percentage of* RO *or* SiO_2 *in the glass.*

Experiments not yet published have shown that RO may also be represented by BaO, SrO, ZnO, or MgO.

It will be seen, then, that the phenomenon is true over a very wide range. It apparently breaks down when the alkali content is much greater than 20 per cent. Since probably every commercial glass on the market today contains less than 20 per cent. of alkali, the statement can be taken as applying to all commercial glasses.

The researches referred to above definitely established the fact that the presence of two alkalies in equal percentage amount by weight in a glass made for better durability. The question at once arose whether having the two alkalies present in equal percentage amounts gave the best durability for a given total alkali percentage, and further research was carried out to try to discover what was the best proportion in which to combine the two alkalies. The present paper gives the results for the lead glasses.

EXPERIMENTAL

(1) Four series of meltings were carried out according to the following scheme:—

TABLE I.

	Series. No.	Percentage SiO_2.	Percentage Alkali.	Percentage PbO.
(1)	205	60	20	20
(2)	212	50	20	30
(3)	206	60	10	30
(4)	211	50	10	40

(2) The batch of every glass in a series contained the same percentage amount of silica, lead oxide, and total alkali, the only variable being the proportion of sodium oxide to potassium oxide. An example of how this proportion was varied is shown in Table II.

(3) The materials used in the batches and the mode of melting were precisely as described in previous papers. In a series of glasses the conditions of melting were kept the same as far as possible.

(4) The solubilities of the glasses were obtained in the usual method described in earlier papers, and for purposes of comparison the values for "milligrams of H_2SO_4 per 100 grams of glass" were employed.

*J. Soc. Glass Tech., 1921, 18, 195-201.
†The Derby Crown Glass Company, Ltd.
[1]Soc. Glass Tech., Trans., 1920, 9, 96-97.
[2]*Sprechsaal*, 1901, 34, 1173.
[3]Soc. Glass Tech., Trans., 1920, 4, 120.
[4]Soc. Glass Tech., Trans., 1920, 4, 97, for the calcium glasses; *ibid.*, 354, for the lead glasses.

(5) Most of the glasses were melted twice, and in some cases three or four times, and the mean of the solubility values was taken. It was found that if several different melts were done with the same batch, the conditions of time and temperature being kept the same as far as possible, and the resultant glasses tested for solubility, the values obtained were never exactly alike. The difference in value between two results was seldom more than 5 per cent., and was probably due to the fact that no two batches had exactly similar

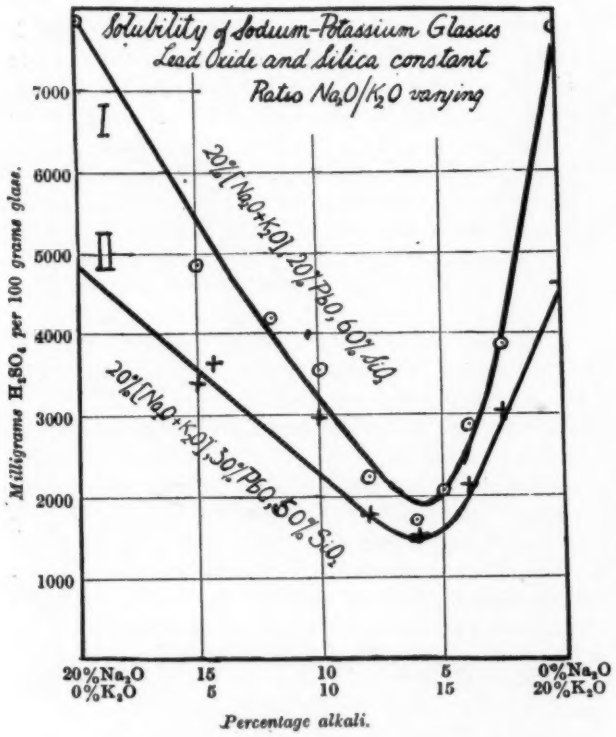


FIG. 1.

attacks upon the pot or suffered exactly similar volatilization losses. Thus the final glasses obtained from like batches would not have identical compositions. The one which had shown most solvent action on the pot would have dissolved the most silica and alumina and would have improved in solubility owing to this circumstance. Since, however, this disturbing factor entered into every individual glass melted, the relationships between the solubilities of the glasses would not be altered, and the conclusions to be drawn remain the same as though no attack had taken place.

Results

The results for series 205 are given in detail in Table II and are shown diagrammatically in Curve I of Fig. 1. The results of the other three series are not given in detail, but will be found in the diagrams. Curve II in Fig. 1 shows the results for the 20 per cent. alkali, 30 per cent. PbO, 50 per cent. SiO_2 series. Fig. 2 shows the results of the 10 per cent. alkali, 30 per cent. PbO, 60 per cent. SiO_2 series (Curve I) and the 10 per cent. alkali, 40 per cent. PbO, 50 per cent. SiO_2 series (Curve II).

TABLE II.

Series	SiO_2	Percentage PbO	Percentage Na_2O	Percentage K_2O	Milligrams of H_2SO_4 per 100 grams of powdered glass
205 *A*	60	20	20	0	7891
B	"	"	15	5	4866
C	"	"	12	8	4178
D	"	"	10	10	3523
E	"	"	8	12	2215
H	"	"	6	14	1680
F	"	"	5	15	2076
J	"	"	4	16	2844
K	"	"	2.5	17.5	3844
G	"	"	0	20	7775

Conclusions

(1) Further evidence has been obtained that the presence of both sodium and potassium in a glass endows it with a greater durability than if only one alkali were present in equal amount.

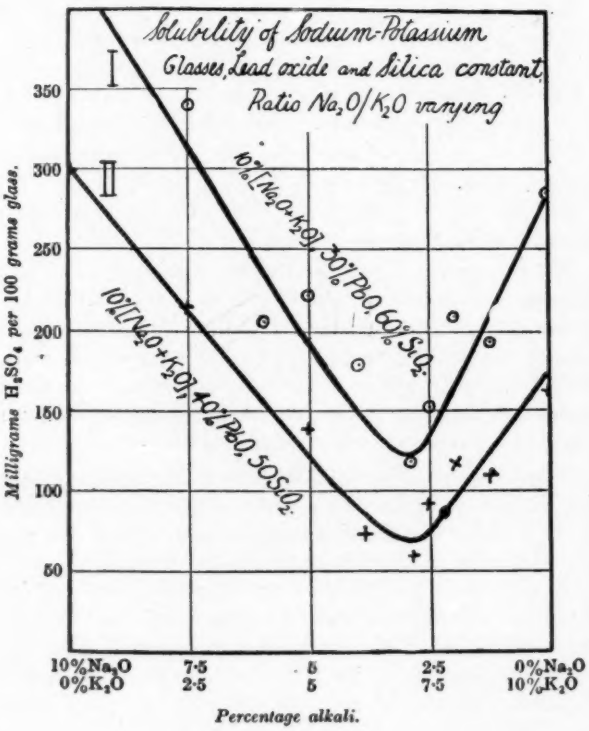


FIG. 2.

(2) *To obtain maximum durability in an alkali-lead-silicate glass the best proportion in which to mix the alkalies is in the ratio of 7 parts of potash to 3 parts of soda. This ratio holds good for all percentages of alkali below* 20 *and is independent of the amount of* SiO_2 *or* PbO *in the glass.*

This rule of solubility is deduced from the curves in Figs. 1 and 2, which all show a minimum point at the ratio $Na_2O/K_2O = 3/7$.

(3) A comparison of the two curves in either Fig. 1 or Fig. 2 emphasizes a fact previously pointed out,[5] that the substitution of PbO for SiO_2 improves the durability of lead glasses when the lead oxide is less than 50 per cent.

(4) A consideration of the results previously obtained

[5]Soc. Glass Tech., Trans., 1920, 4, 355.

with lead glasses[6] in the light of the results obtained in the present paper leads to the conclusion that a glass of the following percentage composition would be most satisfactory in the manufacture of heavy lead glasses:

$SiO_2$42,Na_2O3,K_2O7,PbO48.

The percentage weights are expressed in whole numbers, and such a glass would satisfy in a high degree the conditions of color, density, brightness, durability, melting, and working required in the making of high-grade cut-glass ware.

The author desires to thank his assistant, Mr. W. S. Brown, for considerable help in the melting and investigation of the glasses discussed in this paper.

DISCUSSION

DR. M. W. TRAVERS (*communicated*): In an address to the Society of Chemical Industry in July, 1918, and in a paper read before the Society in November, 1919, I referred to the fact that table-working glasses containing potash as well as soda were less subject to surface attack, and subsequent surface devitrification in the flame, than the glasses which contained soda only. This conclusion was arrived at from the results of experiments carried out at the end of the year 1914, with a view to arriving at a formula for a table-working glass. A number of glasses, most of them taken from pieces of chemical apparatus, were carefully analyzed, but their proportions were only investigated qualitatively. In one of the papers referred to I have called attention to the fact that my conclusions did not appear to accord with that recorded in Hovestadt's *Jena Glass.*

What we may call *"Peddle's generalization"* will serve as a valuable guide to glass manufacturers in designing new glasses, for whether a glass is intended for table working or for optical instruments, surface attack is to be avoided. The work which Dr. Peddle has already carried out appears to cover the simpler glasses, but no doubt the rule applies equally to the more complex glasses, such as are used for the manufacture of chemical glassware.

PROF. W. E. S. TURNER (*communicated*): The value of the use of a mixture of the alkalies, soda and potash in glass-making deserves to be more widely recognized amongst glass manufacturers. Fifty years ago Stas recognized that an alkali-lime glass containing soda and potash in equivalent proportions was superior to other glasses tested both in fusibility and in durability, that is, small solubility. Readier fusibility is rather to be expected on physical grounds. Easy working in the blowpipe flame (lamp-working) is also a feature of soda-potash glass. In this connection, also, soda-potash glasses are noteworthy as producing a high depression point in glass thermometers, and therefore for this reason to be avoided for such instruments.

The durability experiments of Mr. Hodkin and the writer on English crystal glass were too few to be more than sufficient to show that the minimum solubility appeared to lie in the neighborhood of equivalent quantities of soda and potash. Dr. Peddle's results set the minimum solubility very definitely at the ratio of 7:3. Why such a ratio should obtain is not easy to see; it bears no numerical relationship to the molecular weights of these bases. At any rate it should stimulate further investigation, whilst for the glass manufacturer the fact is one which ought to go down in his notebook of fundamental data.

[6]Soc. Glass Tech., Trans., 1920, 4, 365.

Copper Plating Glass

QUESTION.—What is the best way to plate copper on glass? The pieces are window glass, 2 inches by 4 inches. I have tried black lead and lacquer, but don't get a good deposit. I want to plate both sides about two thousandths thick.

ANSWER.—The method used by manufacturers of wireless apparatus, such as Leyden jars, which must have a fairly good coating of copper, is as follows:

1. The glass is coated with a thin coating of alcohol shellac varnish and allowed to dry.

2. Platers' copper bronze powder is mixed with a dilute solution of turpentine copal varnish, and applied to the shellac coating. Two thin coatings are better than one heavy one. After applying the copper bronze powder the surface should be allowed to dry hard.

3. The glass is then plated in an acid copper solution.

Water	1 gal.
Copper sulphate	1¾ to 2 lbs.
Sulphuric acid, 66°.....	2 to 4 ozs.

Voltage, 1. Temperature, normal. Agitate the solution mechanically or with air.—C. H. P. in *The Metal Industry.*

Some Paradoxes Pertaining to Glass

By a Well-Known Glass Man

"Bad Glass" is not due to inherent evil but more probably to sins of omission on the part of the furnace man.

While perfectly proper for blowing methods to be applied in a works, "blowing" by the sales and advertising departments is offensive.

Nature abhors a vacuum. But a Yankee didn't abhor it and produces millions of bottles thereby.

Patents for non-refillable bottles are an anachronism in these arid days when nothing is left to fill the original container.

"Seeds" in a glass flower vase will not sprout nor make such ware salable. Nor does stem-ware imply that seedy glass should be used.

"The Lost Cord" never worries the glassmaker who has eliminated this trouble.

"People who live in glass houses should never throw stones." This would have a more practical significance if people would make glass-house refractories that never throw stones.

Dinner plates are not made from plate glass.

The use of automatic feeders for making food containers is symbolical.

The "Lazy Bones" is a most useful tool.

"Dust to dust, Ashes to ashes." The agitation for glass caskets. Man is dust while glass is dust and soda ash.

Consumption of Lime

About 60 per cent of the total tonnage of commercial lime produced in the United States in 1918 was consumed by about 120 industries (not including the lime used by its manufacturers themselves). The glass industry was the twelfth largest user, taking 35,266 tons.—*National Lime Association.*

Automatic Vial Necking and Bottoming Machines

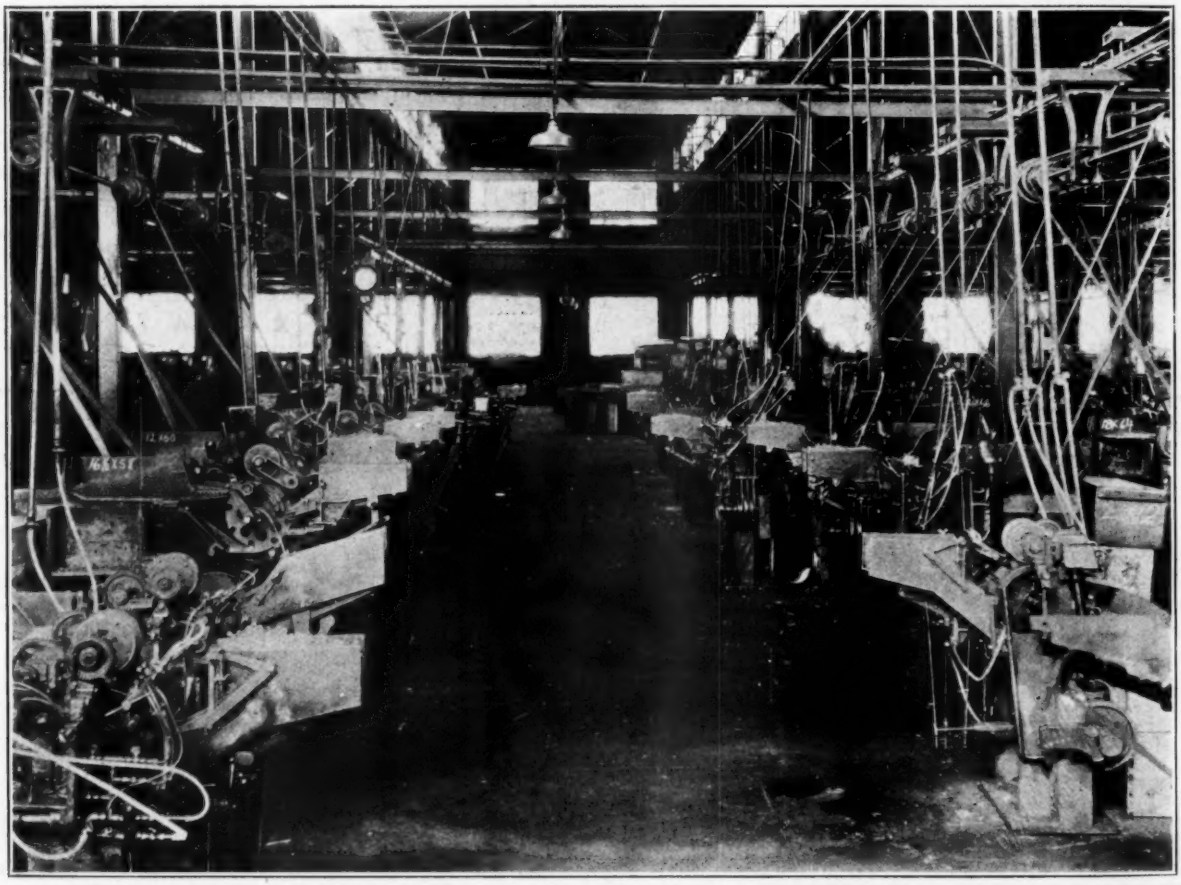
By J. F. SPRINGER

(*Written for* THE GLASS INDUSTRY)

The vial necking machine referred to in an earlier article[1] puts one neck at a time on blanks of a size for two vials. By running a lot of blanks through twice, all the blanks will be properly necked at both ends. The device is the invention of E. E. Kimble and J. M. Levis and the patent taken out in 1911 was assigned to the Kimble Glass Company.

The necking operation includes the proper forming of the shoulder, the neck and the lip. In short, the open end is completely formed. One of the advances in the art is of the forming. The forming tools or dies are brought into action at the proper moments and reduce the diameter of the blanks to form the shoulder and neck and also to limit the reduction of the inside diameter of the neck. After the whole has been approximately formed, the extreme end is faced square with the body of the vial.

The blanks are supposed to be supplied in some quantity in 2-vial lengths. The blanks, which are simply cylindrical tubes cut to proper length, roll down the inclined bottom bars



GENERAL VIEW AUTOMATIC VIAL NECKING MACHINES. THE TWO MACHINES IN LEFT FOREGROUND AND ONE IN RIGHT FOREGROUND ARE "BOTTOMING MACHINES," ALL OTHERS ARE VIAL MACHINES.

claimed for the feature of this device which provides for the pre-heating of the blank while it is still on the carrier approaching the point where the forming is done. Naturally, this has the effect of reducing the amount of work that has to be done at the forming point, and so permits of an increased rapidity of operation. Another feature consists of separating the operation of facing the mouth from the main forming operations and carrying it out subsequently. It is to be understood that this machine is quite automatic.

There are three jets which play upon the work at the scene of the hopper and form a simple layer beneath certain curved members of the feeding device. The tubes roll, one by one, into companion notches of a rotary carrier. A certain frame, together with friction rollers carried by it, will now and again be lifted by the action of a cam. When such a raising occurs, the carrier will be turned a bit through the action of another cam. The amount of this turn is just enough to bring the blank which is riding in the notches to a position where it rests upon rollers. A burner now operates on the end of the blank which is to be formed. This is the preliminary heating already mentioned. When this blank was

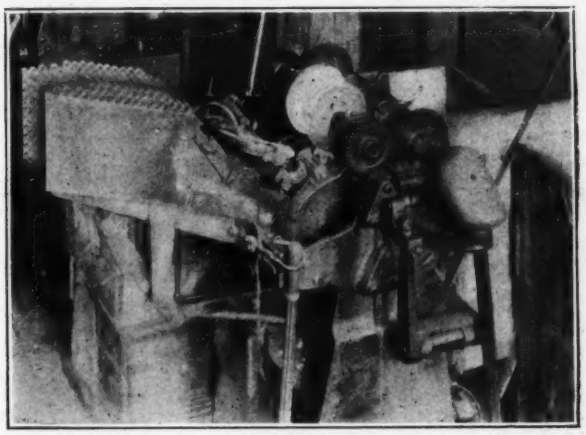
[1] THE GLASS INDUSTRY, Vol. 2, No. 5 (May, 1921), p. 110.

brought into position for this pre-heating, the blank just ahead was moved on to the forming position. Similarly, the present blank will, after the pre-heating has been accomplished, be carried onward, while a fresh blank comes up to be pre-heated. It will be recollected that the pre-heated blank rests on rollers. Another roller, set at an angle to these, comes into action. It rolls the blank and at the same time forces it longitudinally. This action takes place when the frame with its rollers descends to a lower level. The blank is forced longitudinally, as said, and is brought into contact with a certain guide. When now the frame is again lifted, the pre-heated blank, already in contact with the aforementioned guide, is caused to rest upon another set of rollers. When the frame again descends, friction rollers come into action and rotate the pre-heated blank. At this time, two gas jets or blow-pipes heat up the end of the blank. These jets come into and go out of action alternately. A cam operates to turn on and nearly shut off the gas supply at the proper moments. The gas is not entirely shut off because of the necessity otherwise to light up again. The pressure air feeding the jets when in action is alternately turned on and off by another cam. At this juncture—that is, when the jets have been turned off, the principal forming tools are brought into action.

THE BOTTOMING MACHINE

This is, if there is any difference in the appeal, a still more interesting machine than the one which forms the shoulder, neck and lip of a vial on the ends of double blanks. This device takes the completed tubes from the former machine as its blanks and divides them, one by one, half-way between the ends and then forms the bottoms at the points of separation.

There is first of all a magazine where a batch of double blanks have been placed. From each blank two complete vials are to be formed. The blanks are fed automatically from the magazine into the receiving notches of a rotary conveyor. This conveyor does not run continuously, but has an intermittent action. After the conveyor has received a blank, it rotates part of a turn and brings the blank underneath a gas jet. The principal object here is to drive out any moisture that may be in the tube. The next partial turn of the conveyor results in a rearward movement of the blank away from the jet. The blank is now deposited upon a group of eight supporting rollers. A cam now brings about the opening of two valves, one controlling the gas supply and the other a compressed air supply. The effect is that six jets are trained upon the amidships portion of the blank. At this time, the blank is rotated and simultaneously held against an anti-friction disk by a yielding rubber disk. As this disk is in rotation, a rotary movement of the blank results. There is a second rubber member which rotates, but which is not at this moment engaged with the blank. The disk already in contact is so disposed that its beveled face tends to hold the blank up against the anti-friction disk, and in this way the central portion of the blank is permitted to be heated. It is said, however, that the diagonal setting of the axis of this rubber roller is not absolutely necessary, since the yield of the bevel is competent to pull the tube over. After the blank has been rotated a moment and has been pretty well heated all round the center, a companion rubber disk comes into action on the other end of the blank. At this juncture, two of the rubber rollers of the machine co-act to pull the two halves of the blank apart. The result is that the molten glass closes each half. The two vials thus formed are each now resting on four rollers. Each vial is rotated and made to enter the heat zone again. The rotation is now effected by rubber rollers, one to each vial. A second separation of the two halves of the original blank now takes place, the bottoms of the vials being good and hot. By means of a cam, a pair of finishing blades are thrust in between the bottoms, whereupon the vials are made to approach each other once more. The effect is to flatten the bottoms and give that perpendicular relation to the vial axes that is so desirable. Just before the finishing blades are thrust in between the bottoms, the rollers effecting the rotation of the vials are lifted. The result is that when the glass bottoms come against the blades there is no rotary motion of the vials. The conveyor now



A VIAL NECKING MACHINE

carries the two vials, one on one-half of the conveyor and the other on the other half, back towards the rear of the machine. A special burner now acts on the bottoms, annealing them and permitting them to set. The next move of the conveyor discharges the two vials.

Four pockets of the conveyor are always occupied. In the foremost pocket a blank has just been received, in the next towards the rear a blank is getting its preliminary heating, in the next the blank is parted and the two bottoms formed, while in the fourth the two halves of the original blank, now two finished vials, are being cooled and annealed.

Just about the time the finishing blades come into action the gas supply is cut down and the compressed air entirely cut off. The flames do not, accordingly, play upon the work during the smoothing, finishing and forming of the bottoms.

On the same machine more than one size of vial may be bottomed. Certain adjustments are necessary. As a rule, it is not necessary to provide for a greater pulling-apart movement when bigger vials are being made. However, these bigger vials will generally use up a greater length of tubing in the spontaneous action of closing the bottoms. This may leave the closed ends further apart and so require a greater length of movement when the two halves are brought again into the heat zone created by the six gas jets.

The U. S. Patent covering this invention was issued to E. E. Kimble in 1913 and simultaneously assigned to the Kimble Glass Company.

Progress Toward Perfect Packages*

A perfect package may be defined as one which will deliver its contents in a satisfactory manner at a minimum of total cost, all things considered. Among the factors which affect package economy are the cost of raw material, manufacturing, assembling, packing, marking and billing, handling, loading, storage, manner of transportation, losses and damage during transportation, cost of labels, and last but not least the good will of the consumer.

TRANSPORTATION HAZARDS

Transportation ultimately tends to cause failure of packages by weaving or wrenching of the joints, by puncturing or breaking various parts, or by producing collapse. The hazards of transportation are at times very severe, especially during loading and unloading of boats and cars and during storms or when switching cars and making up trains. Light

DRUM BOX TESTING MACHINE AT FOREST PRODUCTS LABORATORY

The boxes shown are packed with electric light bulbs. Four thousand dollars worth of bulbs were furnished by the electric companies for this series of tests to develop a better container.

packages are loaded into a car without proper arrangement and blocking. A light weight fragile box may receive the weight or act as blocking or buffer for large, heavy articles or packages. Perfect packages for export shipment are much stronger than for domestic shipment. In fact export shipments undergo all the hazards of domestic shipments previous to arriving at the wharf for loading. During the ocean voyage the packages encounter weakening effects due to changes in moisture content and temperature. The joints may be loosened or the package crushed when the cargo shifts. After reaching a foreign port there may be a long inland journey under various and often difficult transportation conditions.

PACKING

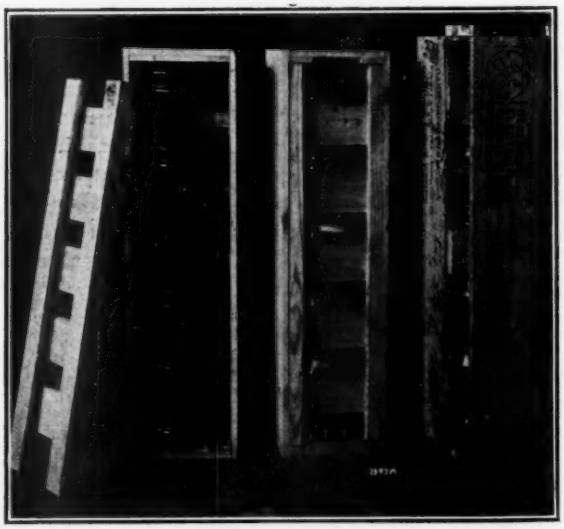
Not only must the package be good but the packing must also receive very careful consideration. Many articles are destroyed or damaged by improper packing when the package itself is not damaged. In fact a very rigid box may contribute to the failure of fragile articles by lack of any cushioning effect when the package receives rough handling.

HANDLING

At the present time there are no standards for handling. One man carefully picks up a package and sets it down, while another would pitch the same package from the top of a load. Some packages are slid down chutes handled in nets or with cables. The method of loading packages on drays, in cars, or in boats has never been studied as it should be, and there are no generally recommended regulations. The perfect package cannot be attained until the methods of handling and loading are made standard and the construction of the package and the methods of packing are reduced to scientific accuracy.

LABORATORY TESTS

The ultimate criterion as to the perfection of any package is the condition of the contents when arriving at its final destination, the cost which has been involved in making the package, and all costs incidental to the journey. In arriving at proper conclusions, it is necessary not only to study first



CONTAINERS FOR EXPORTING HIGH VOLTAGE INSULATORS.

The crate at the right is the original design which failed to protect its contents from breakage, in spite of its apparent strength and durability. The two crates at the left are of the improved design evolved in the box drum tests. The new design saves 20 per cent in shipping space and 20 per cent in lumber in addition to affording superior protection to the contents

cost of the container but also the cost of packing and every condition through which the package must pass before reaching its final destination.

There are a number of institutions which are studying the various phases of the package situation, but the total of such effort nowhere near equals the importance of the investigation. Field investigations are slow and expensive, and very often the cause of certain observed effects cannot be ascertained. The endeavor to bring cause and effect together and reduce the cost of investigation has led to laboratory tests. In the laboratory tests it is the endeavor to produce by known methods of handling, loading, etc., failures which are com-

*From Forest Products Laboratory, Madison, Wis.

monly observed in transportation, and then to change the design of the package so that these failures will no longer occur. It is always essential to observe these redesigned packages in service, in order to determine whether or not the laboratory test has faithfully reproduced the conditions. A perfect package can only be attained through a prolonged period of education and constant study of the ever changing economic conditions.

The manufacturer must understand how to design the best balanced package. For example, in the wooden box there should be no excess of lumber or deficiency of nails. The packer must know how to place and support his material within the package so that the hazards of transportation are least likely to cause damage. The freight handler must be taught proper methods of handling and the amount of rough handling which each and every package can justly withstand. Attention must be given to proper loading in car lots or in l.c.l. shipments. The consumer must be taught he ultimately pays the bill and that to insist that every piece of furniture or every can of fruit come through without mar or scratch of label would entail an expense which he would not be willing to assume. The perfect package is, therefore, not a standard for all time but one which is continually changing and is dependent to a large extent upon the education of everyone from the manufacturer of the container to the consumer. The last 10 years have seen wonderful strides towards the perfect package, but the goal is not yet reached and the good which can be accomplished is as yet but little realized.

The Loss in Weight of the Batch During Melting*

(*Translated for* THE GLASS INDUSTRY.)

The quantity by weight of glass which a batch yields is proportionate to the amount of decomposition which the raw materials (alkalies, alkaline earths and metallic salts) undergo on entering into combination with silica to form double or complex silicates. It is easy to determine the loss of each component of the batch. For example, one molecule of calcium carbonate ($CaCo_3$) is broken up to oxide of calcium (CaO) to combine with silica.

$$CaCO_3 = CaO + CO_2$$

The molecular weight is 100 = 56 + 44. Therefore 100 pounds of calcium carbonate lose 44 pounds. If the same rule is applied to the other constituents, it is found that the losses of the following substances are:

Salt Cake	56.34%
Soda Ash	41.51%
Potash	31.84%

Arsenic, which is often used as a clarifier, is entirely volatilized at the temperature of the glass furnace. The loss of carbon used as coloring material (yellow glass) cannot be determined exactly. This applies also to other organic coloring substances, the use of which is being introduced.

Carbon, which is used as a reducing agent of salt cake, is entirely volatilized.

Then metallic salts are used in the manufacture of colored glass. The following formula gives the quantity in per cent by weight of metallic salt found in the finished product. By subtraction, the loss in weight is obtained,

$$\frac{Y \times 100}{X}$$

in which X represents the molecular weight of the substance used and Y the molecular weight of the substance found in the glass analysis.

The figures obtained are applicable only to chemically pure substances. A correction should be made for impurities, of which the majority (lime, magnesia, iron, aluminum, silica) remain combined in the finished product. The following example may serve to show how the calculation of loss during fusion is carried out. Suppose a window glass batch has the following composition:

Sand	1,000 pounds
Salt Cake	385 "
Limestone	360 "
Anthracite	26 "
Total weight	1,771 pounds

The constituents of the batch will lose during the melting process:

Sand, 1% moisture and organic matter	10.00 pounds
Salt Cake, 56.34%	216.91 "
Limestone, 44.00%	158.40 "
Anthracite, (volatilized completely except ash, estimated at two pounds)	24.00 "
Total loss	409.31 pounds

Or, in round numbers, 410 pounds or 23.15%.

In practice the loss in weight is estimated by calculating the relation between the quantity of raw materials used and the weight of the packed glass. One always obtains a figure higher than 25% for the following reasons:

1. There is always loss due to breakage (cullet).
2. The molten glass always loses by volatilization a small percentage of alkali.
3. The loss due to handling the raw materials.
4. The volatile impurities in the raw materials.

To calculate the composition of a batch from the analysis of the glass the percentages should be multiplied by the corresponding molecular weights of the materials used in the batch, and divided by the molecular weights of the substances as indicated by the analysis. The use of factors simplifies these calculations.

The factor is obtained by dividing the molecular weight of the substance used in the batch by the molecular weight of the corresponding substance found by analysis. These factors should be calculated once and for all, and to calculate a batch from the glass analysis the percentages obtained should be multiplied with the factors.[1] The following three factors are used most frequently:

Calcium oxide		1.786
Sodium oxide	for Salt Cake	2.29
	for Soda Ash	1.71

or, expressed more clearly:

$CaO \times 1.786 = CaCO_3$ (Limestone)
$Na_2O \times 2.29 = Na_2SO_4$ (Salt Cake)
$Na_2O \times 1.71 = Na_2CO_3$ (Soda Ash)

*M. Le Verrier in "Le Verre," 1921, No. 9, p. 182 (September).

[1] A comprehensive table of factors was published in THE GLASS INDUSTRY, Vol. 2, No. 7, July, 1921, p. 159.

The Laboratory

By J. B. KRAK

Decolorizers

The action of decolorizing agents is based on the production of a color which is complementary to one existing in glass. Two colors are said to be complementary when combined they produce white. Such pairs are yellow and indigo-blue, greenish yellow and violet, bluish green and red, orange and blue. Any substance which can produce a slight violet tinge, a very light blue color or a rose pink can be used as a decolorizer, as these colors, when combined with bluish green or yellow of a certain intensity will produce a white color in glass, which to the eye gives the impression of absence of any color. Four substances are mainly used as decolorizers at the present time; namely, manganese dioxide, nickel oxide, cobalt oxide and selenium.

Nearly every mineral and practically every substance derived from minerals contains iron. Certain amounts of iron are always present even in the purest varieties of glass. Glass made in a reducing atmosphere—which is the usual condition—contains iron in the ferrous state and shows a greenish color. If an oxidizing agent has been added to the batch the yellowish color of ferric iron is produced.

Manganese Dioxide or Pyrolusite

Manganese dioxide, usually called manganese, has been used from the earliest days of the glass industry as a decolorizer. Plinius mentions its use as such, and the mineral derives its name, pyrolusite (*i. e.*, fire cleanser) from its use as "glass maker's soap."

Manganese produces a pink to violet color, its intensity depending on the composition of the glass, the quantity of manganese used; the temperature and duration of the melting and fining processes; and on the condition of the atmosphere above the molten metal, whether oxidizing or reducing. The bluish green color, due to ferrous iron, and the violet produced by the manganese are complementary colors and the result is a glass which appears to be colorless.

The color caused by manganese fades when reducing substances are present in the batch or in the atmosphere above the molten glass. These substances reduce manganese to the manganous state, which is colorless. This causes the manganese color to "burn out."

Besides acting as a decolorizer, manganese also acts as an oxidizing agent owing to its tendency to give up oxygen. The liberated oxygen changes the green ferrous iron to yellow ferric iron. A yellow color and a bluish violet may yield white. Soda lime glass, when decolorized with manganese often shows a yellowish tinge which can be compensated for by the addition of a small quantity of cobalt oxide. The blue cobalt color, if present in the proper proportion, neutralizes the residual yellow color. In this case cobalt is used as an auxiliary decolorizer.

Glass decolorized with manganese should show a faint violet tinge when put into the lehr. During the annealing process this color burns out, and the glass becomes perfectly colorless on cooling. If colorless glass is transferred to the lehr, it is apt to show a slight greenish color after the annealing process is completed.

The amount of iron which can be neutralized by the use of manganese is very limited and should not amount to more than 0.1 per cent. Larger amounts of iron cause a distinct greenish or yellowish coloration, especially noticeable in articles made of heavy glass. In this country about one ounce of manganese dioxide is used to each 100 pounds of sand. In Europe from 250 to 300 parts are added to each 100,000 parts of sand.

Prolonged exposure to sunlight brings out the violet color. Window panes in old houses often show the violet manganese color, especially if the building is located in a high altitude. This phenomenon is attributed to the action of ultra violet rays.

Decolorizing with manganese is by no means a simple matter and on account of the uncertainty of the results many glass makers prefer the use of nickel oxide, cobalt oxide or selenium.

ANALYSIS OF MANGANESE DIOXIDE.—Many impurities may occur in this mineral and frequent analyses are necessary. Many samples of pyrolusite contain iron.

ESTIMATION OF TOTAL MANGANESE.—This procedure is based on the oxidizing power of manganese dioxide. The substance is allowed to act on a known excess of oxalic acid which is titrated with standard permanganate solution. Transfer a one gram sample to a 500 cc. Erlenmeyer flask, add 75 cc. of N/2 oxalic acid and 20 cc. dilute sulphuric acid (1:4). Heat until no dark particles remain, dilute with hot water and titrate the excess of oxalic acid with N/2 permanganate solution.

Reaction: $MnO_2 + H_2SO_4 + H_2C_2O_4 = MnSO_4 + 2CO^2 + 2H_2O$ 1cc. N/2 $KMnO_4 = .002173\ MnO_2$.

ESTIMATION OF SILICA AND IRON.—Dissolve a one gram sample in hydrochloric acid, and heat until chlorine ceases to be evolved. Dilute with water, filter and estimate the insoluble residue. Estimate the silica in the usual way by evaporation to dryness. To the filtrate from the silica add concentrated soda solution, drop by drop, until the precipitate which forms dissolves slowly. Add dilute soda solution until a slight permanent precipitate is formed. Add 3 cc. of acetic acid, which should clear the solution. Dilute to about 500 cc., heat to boiling and add 10 cc. of a 30 per cent sodium acetate solution. Redissolve the precipitate in dilute hydrochloric acid and reprecipitate as above. The filtrate contains manganese and zinc, if present. The precipitate contains iron, aluminum and titanium; also cobalt and nickel, if present. The precipitate is weighed, fused with soda, dissolved in hydrochloric acid and the iron estimated by the potassium iodide procedure.

Nickel Oxide

Nickel forms two series of compounds, the nickelous and the nickelic, corresponding to ferrous and ferric iron com-

pounds. During the melting process nickelic oxide is reduced to nickelous oxide. It is therefore best to use the nickelous oxide, the grayish green oxide of commerce. On account of its powerful coloring action very small quantities are used. In sodium glasses, from 2 to 5 parts of nickelous oxide to 100,000 parts of sand are used. In potash glasses the amount is still less. The color, due to nickel oxide, is very constant and as the results are dependable many glass makers prefer its use. On account of the high melting point the decolorizing action is not completed until the end of the melting period, and a sufficiently high temperature is necessary to obtain the best results.

Cobalt Oxide

Cobalt oxide is frequently used as a decolorizing agent on account of the constant results obtained with this substance. The blue coloration is even more powerful than that caused by nickel oxide and very careful weighing is necessary to prevent the appearance of a blue tinge. From ½ to ¾ parts of cobalt oxide to 100,000 parts of sand is considered the proper amount to use.

Selenium

Selenium is an element closely resembling sulphur, with which it is often associated in Nature, and while it is widely distributed it occurs only in small quantities. It is also found in a number of rare minerals. Selenium is obtained principally as a by-product in the manufacture of sulphuric acid, and occurs as a fine dust in the pyrites burners. This dust is first treated with nitric acid, then boiled with hydrochloric acid and the solution gassed with sulphur dioxide, which causes the precipitation of red amorphous selenium. The element also occurs as a black modification having a metallic lustre, and known to the trade as metallic selenium.

Small amounts of selenium produce a rose red tinge, the intensity of which depends on the chemical composition of the glass and the amount of selenium present in the finished product, which in turn depends on the duration and temperature of the fusion. The amount used varies from 1½ to 2½ parts of selenium to each 100,000 parts of sand. It is difficult to obtain exactly the right amount since the effect depends partly on the temperature. A low heat may cause the appearance of a reddish tinge. Since slight changes in temperature are often unavoidable, some glass makers refuse to use selenium. However, when the right conditions are obtained the use of selenium yields a glass of surpassing brilliancy and clearness, such as cannot be obtained by using any other decolorizer.

It has been found convenient to use a slight excess of selenium and neutralize the resulting reddish tint by the addition of a small amount of uranium oxide as an auxiliary decolorizer. This substance gives a yellowish green color which neutralizes the red due to excessive selenium.

Decolorizers may be mixed with the batch, as is usually done with manganese, or they may be added during the melting process. The latter procedure is often preferred with nickel oxide, cobalt oxide and selenium, since only small amounts are necessary.

The proper use of decolorizers is one of the most difficult problems in glass making, an art in which only close attention to all conditions, and long experience can make a master.

Decolorizing Glass

By ASHER BLUM*

(*Written for* THE GLASS INDUSTRY)

The problem of decolorizing glass is of basic importance in the glass industry, as the transparency of glass is one of its chief utilities. Hence, inventors have turned their attention to this problem for many years.

U. S. Patent No. 576,312, issued to Hirsch on February 2, 1897, and which expired on February 2, 1914, was one of the pioneers in this field. This patent recites that antimony, nickel, zinc, lead, the oxides of such metals, arsenious and, pyrolusite and saltpeter have been used for this purpose. The novelty consisted in the use of selenium, which had heretofore been known as useful only for giving glass a rose-red or orange color. The addition of a small amount of selenium, however, produced a fine, white glass. The selenium could be used in its metallic state or as a selenite or selenate.

British Patent No. 1,129 of 1860 to Newton, specifies the use of oxide of nickel as a decolorizing agent, and that it could be used with oxide of zinc as a substitute for oxide of lead in the manufacture of flint glass.

British Patent No. 17,931 of 1895 to Ellis is substantially the same as the Hirsch U. S. Patent No. 576,312 previously discussed.

British Patent No. 1,880 of 1889 to Moser was directed to removing the green tint due to the presence of iron. A mixture of manganese peroxide, selenium, oxide of bismuth, nickelous hydrate, and arsenious acid was used, and vitreous arsenious oxide could be added. The contents of the melting pot were mixed by means of wet sticks of wood, which produced ebullition.

German Patent No. 88,615 to Rechter dated November 4, 1896, is substantially the same as the Hirsch U. S. Patent No. 576,312.

German Patent No. 103,441 to Drossbach dated July 19, 1900, states that the blue-green color of ordinary glass is removed by means of compounds of neodymium or erbium containing small quantities of cerium and praseodymium.

German Patent No. 108,595 dated April 19, 1900, to Moser specifies the use of a mixture of manganese dioxide, selenium, bismuth oxide, nickel hydroxide and arsenious acid.

*Of Mock & Blum, patent attorneys, New York.

Museum Gets Old English Glass

The Metropolitan Museum of Art, New York, announces the receipt of a gift of a valuable collection of old English glass from the estate of Edward Holbrook of 193 pieces. This is the work of the English glass makers at their best period, 1680 to 1810. The collection consists largely of wine glasses with various form of baluster stems, showing the air bubble or "tear" device for ornamentation in the stems with the succeeding fashion of threads of apoque white or colored glass, after the Venetian manner, the later forms with the stems of cut glass. There are also a few examples of Dutch and German glass in the collection.

Glass and glassware were imported into New Zealand in 1914 to the value of $870,592; in 1919, $1,108,661; in 1920, $2,953,761.

The Glass Industry

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ADVERTISING RATES ON APPLICATION

NEW YORK, NOVEMBER, 1921

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CLASSIFIED BUYERS' GUIDE, PAGE 7

CERAMICS. A manual for chemists, engineers and manufacturers, by A. Malinovsky, Ceramist. Size 7 x 4½ inches, 274 pages. Published by D. Van Nostrand Company, New York.

This volume contains in a condensed form a treatise on the silicate industries, methods of qualitative and quantitative analysis of silicates, ceramic calculations, chapters on Seger cones and their melting points, minerals used in the ceramic industries and many useful tables. It should be interesting to those engaged in the ceramic industries and to glass makers who manufacture their own refactories. No special data on glass are included.

A Standard Work on Glass Manufacturing

The student of technology can acquire reliable information on almost any subject through the use of a number of carefully compiled text books, which appear from time to time and which keep abreast of developments in various industries. In some lines of technology there is such an abundance of hand books that the greatest difficulty lies in the proper choice. It is fortunate that this should be so, for the existence of good text books is a distinct help towards the development of any industry. They enable the beginner to continue where predecessors have left off and are a stimulus to progress.

The glass industry, however, presents a notable exception to this state of affairs. Strange as it may seem, there is no denying the fact that there exists today no comprehensive work on glass making in the English language. The few books which are available are entirely too superficial in their treatment of the subject and furthermore they are without exception, hopelessly out of date. There is an urgent need for a standard work on glass manufacturing as it stands today.

The French technical literature is in no better condition as regards modern glassmaking than our own, but can point to the work of Bontemps and the more recent publication of Appert and Henrivaux as examples of hand books-which-used-to-be. Dralle's admirable work, "Die Glas Fabrikation" is undoubtedly the best and most complete treatise on every phase of the industry. However, the mechanical part of the book is already far behind present day developments, and since it appeared the chemical and physical conceptions of glass and glassmaking have undergone some fundamental changes due to recent studies.

This void in the literature of glassmaking is the more surprising since there are two periodicals published in the English language of which one is wholly given to glass technology while the other devotes considerable space to the subject. Reference is made, of course, to the *Journal of the Society of Glass Technology of the United Kingdom*, and to the *Journal of the American Ceramic Society*. In no other language is there such a wealth of periodical literature on glass technology, and investigators of the United States and of Great Britain are at the present time in the very first line of advance into the domain of the unknown.

The time when one man could write a book on glassmaking is past. But there are living today a number of experts who would be willing to cover the field of their specialty, provided a man of outstanding personality in the glass industry could be found, who would undertake the editing of a standard work on glass technology in the English language. To the realization of this enterprise, American and British manufacturers, experts and scientists should be called upon to contribute their share towards the advancement of knowledge and the instruction of the coming generation. The publication of such a work would be a powerful help to further growth of the glass industry.

[EDITORIAL NOTE—Since the above matter was written it has come to our attention that a book of the kind needed is being prepared by a prominent chemist and glass technologist. —ED.]

Technical Consultation Service

THE GLASS INDUSTRY invites its readers to refer to this department any problems with which they may be confronted pertaining to raw materials, glass technology, laboratory and factory practice. While making no pretensions to the possession of unbounded knowledge or infallibility THE GLASS INDUSTRY is ready to assist its readers to the best of its ability in solving their problems. Readers who can offer better suggestions are invited to submit them.

Answers to all questions will be made by mail as promptly as possible. The source of all inquiries will be held in strict confidence.

QUESTION 13.—We would appreciate your advising us regarding the following: In putting out machinery which is applicable to all types of continuous glass tanks making all kinds of ware, what is the basis generally used in figuring royalties? Is the cost data figured on the tonnage of glass or the unit gross?

ANSWER.—We are advised by a glass manufacturer as follows: Royalty on patented machinery manufacturing window glass is based on the square or per 100 squares for the ware actually packed and not ware made. This is true of both first and second grades of glass regardless of the quality as long as it is packed for sale. As to bottles the basis might be by the dozen or the gross. On this class of ware the same amount is paid for all sizes of bottles, whether large or small, and the same rule holds good as to quality of glass; that is, whether it be first or second grade the royalty is figured on the amount of ware packed for sale. As to the cost data, jars of various descriptions and jelly glasses are usually figured by the dozen or gross, and never, so far as we know, by weight. However, bottle cost is figured both ways, by the dozen or tonnage. This, of course, varies with the different methods in use by the different firms and in some instances both gross and weight is used in figuring costs. As to table ware, packers' line, etc., the method most common in figuring costs is based on 100 pieces, in fact this system is becoming more universal in all lines each year. Figuring on the 100 piece basis, of course, the calculations can be more readily pointed off decimally and therefore handled in a much more simple manner.

Some automatic bottle machine and feeder manufacturers issue licenses for specific periods, charging an annual license fee and a royalty on each gross of manufactured ware, in some cases limiting the user of the machinery to the manufacture of certain types of ware. Certain other patented automatic machinery is sold outright without manufacturing limitations of any kind or royalties.

New Books

SILICA AND THE SILICATES, by James A. Audley, B.Sc., Ceramic Chemist. Size 8½ x 5½ inches, 359 pages. Published by D. Van Nostrand Company, New York.

This volume is one of a series of monographs, giving a comprehensive survey of the chemical industries. In keeping with the general aim of the series, the author has covered a large range of subjects within the limits of a single volume. For this reason a more or less arbitrary selection of the material has become necessary, reflecting lines of special interest to the author. This disadvantage, however, is in a large measure compensated by the inclusion of complete lists of reference books, so that the reader can easily obtain additional information on many subjects. Sixty-two pages are devoted to glass making.

A HANDBOOK OF LABORATORY GLASS-BLOWING, by Bernard D. Bolas. Published by George Routledge & Sons, Ltd., London, and E. P. Dutton & Co., New York. Size, 8x5 inches.

Definite information is something very hard to obtain. It is given on the subject of laboratory glass-blowing in this volume by one who understands the art and also knows the lack of familiarity of the average chemist with this comparatively simple craft.

Starting with easy examples the reader is shown how to make simple pieces of apparatus until finally instruction is given in the making of filter pumps, Soxhlet tubes, potash bulbs and enclosed thermometers. The volume contains numerous illustrations. The publication of this book will be appreciated by chemists and students and it will prove a valuable addition to any laboratory library.

Journal of American Ceramic Society

In the July issue of the *Journal of the American Ceramic Society*, Robert J. Montgomery, of the Bausch & Lomb Optical Company, discusses the results of a study of the relations between the composition of barium glasses and their optical constants. The article contains a number of general rules for proportioning batches. Donald E. Sharp, of the Spencer Lens Company, publishes a paper on the design of a furnace for annealing optical glass. The lehr is constructed in such a manner that uniformity of temperature is obtained.

Other articles in this number are:

THE METALLOGRAPHY OF THE OXY-ACETYLENE WELD AS AFFECTED BY ENAMELING, by E. P. Poste;

THE SEPARATION OF LIME FROM DOLOMITE, by H. G. Schurecht;

PLASTIC MAGNESIA CEMENTS, by P. H. Bates and Roy N. Young;

THE TRANSVERSE STRENGTH OF FIRE CLAY TILES AT FURNACE TEMPERATURES, by R. F. Geller.

The editorial section is devoted to the plans of the new general secretary, Ross C. Purdy.

Journal of the Society of Glass Technology

The August number of the *Journal of the Society of Glass Technology* contains the reports of the 43rd, 44th and 45th meetings of the third annual dinner of the Society and the fourth annual report of the Council. The following articles appear in this issue:

THE EFFECT OF SILICA AND SODIUM OXIDE ON THE THERMAL EXPANSION OF GLASSES. By S. English and W. E. S. Turner.

ON THE QUANTITATIVE STUDY OF TECHNICAL PROBLEMS IN THE GLASS INDUSTRY. (Presidential address), by Morris W. Travers.

AUTOMATIC GLASS FEEDING DEVICES. By G. Dowse and Edward Meigh.

THE EFFECT OF THE RAYS FROM RADIUM, X-RAYS AND ULTRA-VIOLET RAYS ON GLASS. By J. R. Clarke.

THE HEAT BALANCE OF A PLANT CONSISTING OF AN AIR-STEAM BLOWN GLASS PRODUCER AND A GLASS TANK FURNACE.

THE THERMAL EXPANSION OF GLASSES CONTAINING ALUMINUM. By S. English and W. E. S. Turner.

THE RELATIVE ADVANTAGES AND DISADVANTAGES OF LIMESTONE, BURNT LIME AND SLAKED LIME AS CONSTITUENTS OF COMMON GLASS BATCHES, CONTAINING SODA-ASH AND SALT CAKE. By F. W. Hodkin and W. E. S. Turner. (Reprinted in THE GLASS INDUSTRY, October, 1921.)

THE DEVELOPMENT OF VARIOUS TYPES OF GLASS.—PART XI. The Effect of the Joint Presence of Sodium and Potassium on the Solubility of Lead Glasses. By C. J. Peddle. (Reprinted in this issue of THE GLASS INDUSTRY.)

The number contains 103 abstracts of articles which have been published in periodical literature.

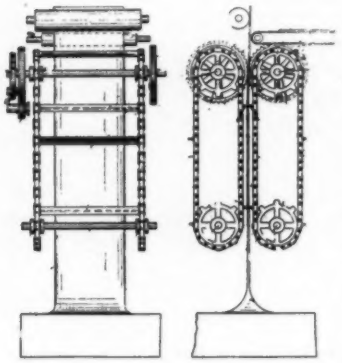
Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Copies of the Patent Specifications mentioned below may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c. each.

Apparatus for Drawing Sheet Glass. U. S. 1,386,724. Aug. 9, 1921. Thomas S. Owens, Toledo, Ohio.

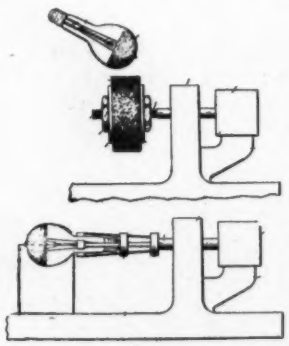
This invention relates to the manufacture of sheet glass and particularly to means for continuously drawing glass in sheet form from a source of molten glass supply.



The object of this invention is the provision of improved means, of the character described, which is simple and efficient in its construction and operation and adapted to have effective drawing engagement with the sheet being drawn, and at the same time to have minimum contact therewith, thereby avoiding the surface marring or injury of the sheet occasioned by drawing the same over or between rolls or other means having a more or less continuous contact with the sheet, as now commonly practised and maintaining the sheet with its original surface glazed.

A further object of the invention is the provision of means which, in addition to acting as a drawing means for the sheet, also serves as a means for transversely scoring or weakening the sheet at spaced points longitudinally thereof, whereby the sheet may be subsequently and successively broken into sections along such weakened lines.

Frosted Glass and Process for Making the Same. U. S. 1,386,880. Aug. 9, 1921. Charles F. Lorenz, of Cleveland, Ohio, Assignor to General Electric Company, a corporation of New York.

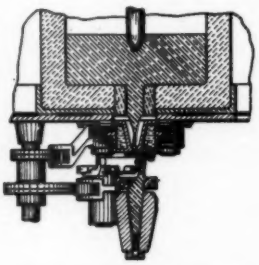


This invention relates to methods of finishing glass or similar surfaces, and is particularly adaptable to the producing of frosted surfaces on incandescent lamps or other glass bodies to be used for light transmission. The object of the invention is to provide a finish for the glass surface of the lamp bulb which may readily be applied without injury to the surrounding surface, which will screen the light source from the eyes, which will not be readily affected by dirt, and which may be easily cleaned without injury to the surface.

By this invention, the surface to which the finish is to be applied is first sand-blasted in the usual way. An abrasive such as emery is then applied to the surface by means of a rotating moist brush or pad, or thear ticle may be rotated and the abrasive applied by means of a moist pad or brush. No special care need be taken to prevent the moist pad or brush from coming in contact with the unfrosted surface of the article as by this method only the frosted portioni s acted upon by the abrasive. After the emery has been applied or rubbed on for a sufficient length of time to remove the coarseness of the previous sand-blast, the emery pad or brush is removed from contact with the surface. The surface is then cleaned.

Apparatus for Manipulating Hot Glass. U. S. 1,390,448. Sept. 13, 1921. Richard La France of Toledo, Ohio, assignor to the Owens Bottle Machine Company, of Toledo, Ohio.

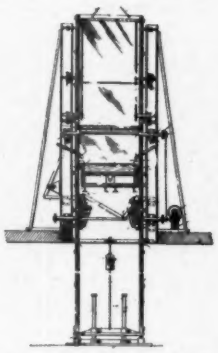
This invention relates to apparatus by which a continuously flowing stream of molten glass is segregated into individual gathers or masses to be introduced into forming molds.



In the co-pending application of Joseph B. Graham, Serial Number 174,697, there is shown apparatus of the character above indicated, comprising a sectional cup placed directly beneath the flow opening into the bottom of a receptacle containing molten glass.

The present invention comprises certain improvements on the apparatus disclosed in the Graham application, comprising a modified form of sectional cup, a modified operation of the knife, and an improved form of knife. According to this invention, the opening in the bottom of the sectional cup is narrowed or restricted and the cup so formed that the knife after severing the glass may be withdrawn instantaneously. The glass is then supported by the side walls of the cup as the gather accumulates. The knife operating mechanism is formed to effect this quick withdrawal of the knife. The primary purpose of this operation is to reduce to a minimum the length of time the knife is in contact with the glass to thereby avoid chilling of the glass and thus eliminate the usual scar produced in the finished ware by such chilling.

Sheet-Glass Drawing Machine. U. S. 1,391,405. Sept. 20, 1921. Clarence R. Rhonemus of Charleston, W. Va., Assignor to the Libbey-Owens Sheet Glass Company of Toledo, Ohio.



This invention relates to the art of drawing sheet glass, and has for its object to provide means for the continuous drawing of the glass in sheet form and severing it into sections during the drawing operation.

In this drawing operation, the glass tends to rapidly narrow to a string or thread which would become severed from the molten mass and the drawing operation thus interrupted before a sheet of any commercial value was formed, and it is therefore necessary to provide means for overcoming this narrowing tendency of the sheet during the drawing operation if a continuous sheet, or one of any practical size, is to be drawn.

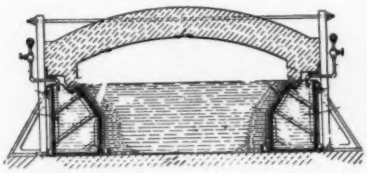
By the present invention, there is provided any suitable receptacle for molten glass, preferably in the form of a pot in open communication with a glass-melting furnace, which pot is provided with means for maintaining the desired temperature of the molten glass, and on opposite sides of the pot overflow points are

provided at approximately the level of the molten glass, and in reality slightly below the level through or over which small lateral streams overflow outwardly, which streams of outwardly flowing glass are received by vertically moving tubes or channels. The overflow portions preferably are in the form of overflow lips, and the glass-receiving tubes are divided into longitudinal sections which are hinged together in such way as to leave a vertical longitudinal slot in the tube. As the molten glass overflows from the lips on opposite sides of the pot, it enters the tubes through the slots, and as the tubes move vertically upward, they act to counteract the narrowing tendency of the sheet and thereby maintain it of a uniform width.

Glass-Tank Furnace. U. S. 1,390,614. Sept. 13, 1921. Joseph E. Hurley of Jeannette, Pa.

This invention relates to glass tank furnaces.

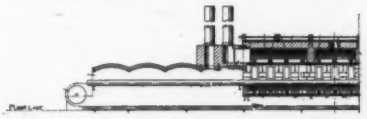
In a patent granted to A. O. Hurley on the 20th day of June, 1905, No. 792,705 there is illustrated and described a glass tank furnace in which the walls of the furnace consist of water tanks with a wooden facing, and a trough at the top of the tank, the idea being that the glass adjacent to the tank will become chilled, forming a layer of chilled glass along the sides of the furnace and the molten glass flowing into the trough will act as a seal and at the same time will tend to bind or lock the layer of chilled glass extending down along the sides of the tank and prevent its slipping down. The result is that the hot molten glass does not have an opportunity to reach the walls of the furnace, but is held within a receptacle, as it were, of chilled glass, as there is generally a layer of semifluid or partially solid glass on the bottom of these furnaces due to the chilling action of the bottom.



The object of the present invention is to give further protection to the walls of a furnace of this character and to these ends the invention consists generally stated in providing for the circulation of the cooling medium between the walls of the tank and the wooden facing, all as more fully hereinafter set forth and claimed.

Decorating or Annealing Oven. U. S. 1,389, 583. Sept. 6, 1921, Chauncey E. Frazier, of Washington, Pa.

This invention relates broadly to decorating furnaces, and more specifically to a furnace or oven of the muffle type designed for burning or fixing decorations on articles of glassware, ceramic ware and enamel ware, and also adapted for annealing purposes.



The primary object of the invention is to produce a muffle oven which has a construction and arrangement providing for the firing or decorated ware for fixing the pigments or other substance employed in the decoration, for annealing or re-annealing of glass, or the like, and which affords means whereby may be controlled the temperature to which the ware is subjected, the rate at which the ware is heated to the maximum temperature, and the rate at which the fare is cooled following heating to the maximum or following a predetermined reduction in the temperature.

Glass Factory Equipment and Supplies

THE GLASS INDUSTRY will be glad to publish descriptions of new and useful devices, machinery and supplies of interest to the glass manufacturing trade. Most of the information printed in this department comes direct from the manufacturers of the products described.

Mold Company Reports Progress

In these days of industrial depression it is exceptional to find either new or old concerns reporting progress and growth. One such exception, however, is that of the United Mould Company, Toledo, Ohio.

FACTORY OF THE UNITED MOULD COMPANY, TOLEDO, OHIO

In operation less than a year, this company reports that under the management of E. J. Muir, formerly an executive of the Flint Glass Workers' Union, they have gone steadily forward through the worst year the glass business has ever known, enlarging their plant from time to time and increasing their working force, yet being compelled at times to resort to night work to take care of rush orders.

Mr. Muir states that during the year his concern has filled orders for large and small glass factories for molds for bottles, shades, automobile lenses and all kinds of pressed ware for tableware manufacturers. He attributes the success of the company to the skill of their mold makers, a spirit of fair dealing with their customers and to a determination to establish the company and make good even under adverse conditions.

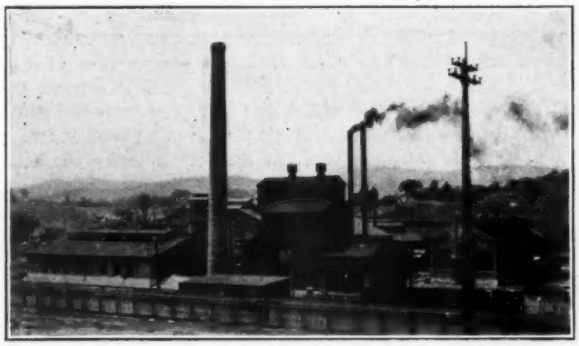
Commercial Production of Glass Caskets

Widespread interest has been aroused by the recent announcement of S. W. Manning that the Glass Casket Corporation, Altoona, Pa., of which he is president, has succeeded in overcoming the obstacles in the way of producing on a commercial scale, glass burial cases of adult size. An account of the methods employed and the equipment used in achieving this success is given below.

The caskets, manufactured at the company's Altoona, Pa., plant, measure 6 feet 3 inches in length. The approximate weight of the bowl or base is 160 pounds and the lid weighs about 95 pounds, a total of approximately 255 pounds of glass, not including any fittings or trimmings.

The glass is melted in a modern 40-ton (per 24 hours) capacity tank for which all the refractory blocks were furnished by Laclede-Christy. Producer gas is the fuel used.

In making the caskets the glass is ladled from the tank with a ladle swinging on a crane or trolley and considerably more glass is in the ladle than is required to make a casket. The ladle is made of fairly thin metal which heats rapidly and to which the glass that is in immediate contact with the ladle, adheres. The



VIEW OF PLANT OF GLASS CASKET CORPORATION, ALTOONA, PA.

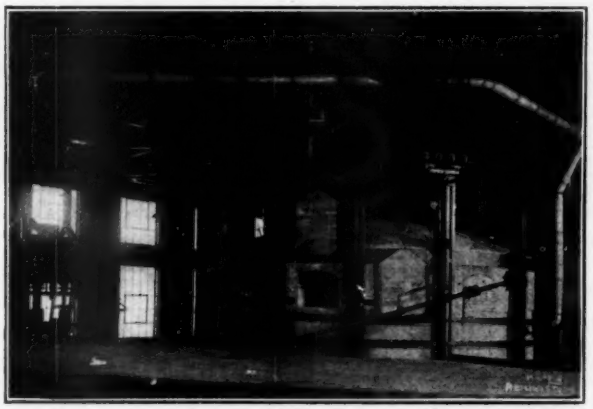
hot glass is then poured into the mold and the shell adhering to the ladle is thrown back into the furnace to be re-heated. This prevents scars due to the cold shell which was in contact with the ladle. As soon as the glass is poured into the mold no time must be lost in getting it pressed, for while the mold is at a working temperature, still it is much colder than the glass and quickly starts building up a tough skin which is difficult to displace with the press plunger. Contrary to what would generally be expected, which would be that the glass must be deposited perfectly in the center of the mold, it was found that a casket could be made just as well if all the glass were put in one end of the mold. This was quite a surprise and was attributed to the extreme rigidity of the press.

THE PRESS AND MOLD

The press was built and installed by Wm. J. Miller, Swissvale, Pa., who also furnished the molds, one set 6 feet 3 inches in length, weighing 23,000 pounds, and one set 5 feet 9 inches, inside, weighing 20,400 pounds. About six months' time was required for the completion of the molds.

It required considerable experimenting by skilled founders to get iron that they could depend upon to cast flawless molds of this size. A special large air hammer was employed to chip out the radii and angles of the interior, whereas the straight runs were cut out on a planer. The mold is one solid casting but has a floating valve in the bottom for elevating the finished ware out of the mold. The difference in expansion between the valve and the mold was one of the greatest difficulties that had to be contended with. There was also considerable difficulty with the difference in expansion between the plunger and ring but this was anticipated by making up a sectional ring that would expand and thereby compensate for the difference in temperatures between ring and plunger. There is also a tendency for the plunger to run cold in the shoulder which chills the edge of the casket too much. This was anticipated by making a sectional plunger and insulating the base from the plunger proper. These difficulties were encountered in the preliminary tests made at the American Glass Casket Company's plant at Ada, Okla., and also with the National Glass Casket Company's installation at Monaca, Pa. They also had difficulties with the difference in the expansion between valve and mold. In pressing the caskets, considerable difficulty was at first experienced, especially at Ada, Okla., in preventing the sides from falling away from the mold immediately after they were pressed and was overcome by using a wooden paddle to smooth them to the mold walls. The falling away was caused chiefly by the sucking action of the plunger as it was withdrawn.

At Altoona, Mr. Miller reports, there was absolutely no trouble in pressing up the caskets and they required much less power than had been estimated. Whereas the pressure required had been estimated at 450 tons, there was no difficulty in making them at 200 tons. Of course, as the viscosity of the glass increases, or, in other words, as stiffer glass is used, more power is required and also the rapidity with which the glass sets or chills, has considerable effect on the power required. The length of time the glass lays in the mold before it is pressed also affects the power required to press it.



40-TON GLASS TANK, REFRACTORY BLOCKS FURNISHED BY LACLEDE-CHRISTY

Removing the casket from the elevated valve of the mold to the lehr presented quite a problem for some time and was overcome by various contrivances, such as encircling with a light steel frame or basket, sliding the casket onto a paddle or picking it up with a fork on a crane. The tempering for a time was the greatest problem and was solved at the Altoona factory by the building of a special lehr, having an extraordinary long fire box and protected from the entrance of cold air or drafts. It was also necessary to make the glass of a composition giving a low co-efficient of expansion.

The press installed at the Altoona factory is the largest glass press in the world. The dimensions are 6 feet wide, 20 feet long, 11 feet high. Weight 39,000 pounds. Extreme power, 900 tons. This is 20% larger and more powerful than the press installed by Wm. J. Miller for the American Glass Casket Company at Ada, Okla., several years ago. It is more modern in that very little manual labor is required, one man being able to operate it. Hydraulic power is used exclusively. The pressing is done by two 24-in. dia. by 22-in. stroke hydraulic cylinders and the shifting of the mold is accomplished by a hydraulic cylinder. The ware is also discharged by means of a hydraulic cylinder. At 2,000-lb. water

pressure, it will develop 900 tons on the rams. It will accommodate molds 48 inches wide by 100 inches long by 30 inches high and will make a container 36 inches wide by 88 inches long by 20 inches high, but can be built to make still taller ware. Comparatively little power is required to operate the press due to the high efficiency by hydraulic power as compared to compresed air. The entire outfit can be operated with a ten h.p. motor.

At the Ada, Okla., plant of the Glass Casket Corporation the press installed is a Miller A-type. The machine at Altoona is what is known as the U-type in which the pressing is done by lifting the mold to the plunger instead of causing the plunger to descend into the mold as on the ordinary standard presses.

Three similar A-type presses are located in the DeCamp factories at Ada, Okla.; Chattanooga, Tenn., and Streator, Ill. U-type machines are at Cedar Grove, La., and Altoona, Pa. The model A-type presses are all provided with hand mold shifts and the pressing is accomplished by an air cylinder, transmitting its power through patented toggle pressing mechanism.

THE LEHR

The lehr installed by the Simplex Engineering Company, Washington, Pa., is built like any standard continuous lehr and is 8 feet wide by 83 feet long and is equipped with standard Simplex muffled fire-box of the flat arch type. The fire-box is special in regard to length; the idea being to keep the casket under the influence of the fire for a greater length of time than is necessary in articles of a lesser weight. This necessity is due to the fact that it required a longer soaking period.

LEHR INSTALLED AT PLANT OF GLASS CASKET CORPORATION BY SIMPLEX ENGINEERING COMPANY

The casket is placed in the fire-box the long way across the lehr; the object in this being to keep the casket under the influence of the fire-box for a greater length of time and to allow a more gradual cooling. Very little trouble was reported in the annealing of the caskets. The caskets are in the fire-box or annealing chamber proper for a period of slightly more than two hours during the soaking period and practically four hours are required to reduce the temperature to the point where the ware can be handled.

In connection with the annealing of the caskets, Mr. Manning states that in one short run, 17 out of 20 caskets were saved, which goes to show that the product is not a "mere accident of manufacture."

The Altoona plant of the Glass Casket Corporation is modern and well-equipped for the purpose it was designed for and includes a trimming and finishing room where the caskets are assembled, framed, painted and draped as required.

Visible evidence of Mr. Manning's success in molding and pressing adult size caskets is found in the product itself. In view, however, of the many failures in the past of attempts to make glass caskets and somewhat general skepticism throughout the glass trade as to the possibility of successfully annealing such large objects as adult size caskets, Mr. Manning has anticipated criticisms from unbelievers and opponents and has fortified himself with convincing proofs of the quality of the glass of which the caskets are composed. A sample of the glass was sent for testing to the United States Bureau of Standards at Washington, D. C., and another sample to the Technical Editor of THE GLASS INDUSTRY. The Bureau of Standards and the laboratory to which THE GLASS INDUSTRY entrusted the testing of its sample both reported that the samples were well annealed.

To still further disarm criticism, Mr. Manning has furnished THE GLASS INDUSTRY with an affidavit made by Alfred Bowman, the company's factory superintendent, setting forth that the two samples referred to above were broken by him personally from glass caskets 6 feet 3 inches long, made from raw materials at the Altoona plant; and an affidavit from Roy M. Nolan, assistant secretary of the Glass Casket Corporation, setting forth that he personally received the samples from Albert Bowman and mailed one of them to the Bureau of Chemistry (who in turn submitted it to the Bureau of Standards, Washington, D. C.,) and mailed the other sample to the technical department of THE GLASS INDUSTRY. In view of the evidence submitted, Mr. Manning seems to have substantiated his claims that his company has been successful in pressing and annealing adult size glass caskets and to be entitled to the honor and rewards his courage and persistence deserves.

BATCH MIXER INSTALLED AT PLANT OF GLASS CASKET CORPORATION

As an indication of public interest in the glass burial case innovation it is stated that a display of finished caskets made recently at Altoona, Pa., was visited by 25,000 persons within a week of its opening.

Engineering Societies' Employment Bureau

The wide and varied field of engineering activity has created the need of some great clearing house of engineering services from which engineers of any specific qualifications may be obtained.

In recognition of this want, the Federated American Engineering Societies, representing a combined membership of about 50,000, including the best and most representative professional engineers in the United States, has established at 29 West 39th Street, New York, an employment bureau for engineers of every variety of training and experience.

Applicants must be members and submit a complete educational and professsional record which is carefully classified, so that as the special requirements of any position are received, the records of men of suitable qualifications are submitted for consideration. The relatively large number of men with whom the Bureau is in touch, the comprehensive classification of records, and the fact that the services of the Bureau are free to employer and member alike, renders possible the selection of the right man for the service required. Negotiations may be confidential if desired.

The high standards required for membership in any of the member societies insure the quality of men available and the Bureau will welcome inquiries from those seeking to build up or expand their engineering organizations in preparation for the increased activity now manifest.

The Training of the Glass-Works Chemist*

By Alexander Silverman†

In an article which appeared recently in the *Pottery and Glass Record* and was reprinted in an American journal[1] Dr. W. E. S. Turner of the Department of Glass Technology of Sheffield University called attention to the lack of a course in Glass Technology in the curricula of our institutions of learning. The writer outlines the following course of study to "start the ball rolling," and invites discussion. Numbers indicate the actual hours per week scheduled for classes, the first figure signifying lecture and recitation hours, the second, laboratory.

FIRST YEAR

First term.—General inorganic chemistry (4-6)
General physics (3-3)
Advanced algebra (5)
German (3)
English (3)

Second term.—General inorganic chemistry (4-6)
General physics (3-3)
Trigonometry (5)
German (3)
English (3)

Third term.—General inorganic chemistry (4-6)
General physics (3-3)
Analytical geometry (5)
German (3)
English (3)

Fourth term.—Such General work in a glass factory as requires no special technical training.

SECOND YEAR

First term.—Advanced inorganic chemistry (2)
Qualitative analysis (1-9)
Advanced physics (Light) (2-6)
German or French[2] (3)
Analytical geometry (5)

Second term.—Advanced inorganic chemistry (2)
Qualitative analysis (1-9)
Advanced physics (Heat) (2-6)
German or French (3)
Calculus (5)

Third term.—Advanced inorganic chemistry (2)
Quantitative analysis (1-9)
Advanced physics (Study and determination of physical properties of glass) (2-6)
German or French (3)
Calculus (5)
Graphics (3 practice)

Fourth term.—General work in a glass factory.

THIRD YEAR

First term.—Physical chemistry (3-3)
Quantitative analysis (1-9)
Mineralogy (2-6)
Gas and fuel analysis (2-6)
French (3)

Second term.—Physical chemistry (3-3)
Quantitative analysis (Raw materials for glass) (1-9)
Geology (5)
Fuel values. Pyrometry. (3)
French (3)

Third term.—Physical chemistry (3-3)
Quantitative analysis (Glass) (1-9)
Microscopy (1-6)
Organic chemistry (2-6)
French (3)

Fourth term.—Analytical laboratory practice in a glass factory.

FOURTH YEAR

First term.—Clays and refractories (2-6)
Glass technology (2-6)
Ceramic calculations (2)
Engineering laboratory (2-6)
General economics (3)
Library work (5)

Second term.—Glass technology (3-9)
Ceramic calculations (2)
Electrical engineering (2-6)
Economics (Factory management) (3)
Library work (5)

Third term.—Glass technology (3-12)
Electrical engineering (2-6)
Economics (Labor and costs) (3)
Library work (5)

The writer considers it necessary to discuss only a few of the courses in detail, as most of those listed are familiar to all engaged in teaching. In the short courses in mineralogy and geology special attention must naturally be given to raw materials used in the glass industry. The course in microscopy should cover both microchemical and petrographic methods.

Under glass technology one should include furnace and lehr design; fuels; raw materials; preparatian of batches; melting and refining; furnace control; glass manipulation; annealing; physical and chemical properties of glasses; manufacture of plate, window, bottle, illuminating, chemical, optical, water glass, table ware and fused quartz; etching, silvering, enameling and decorative processes; glass substitutes. The laboratory work should include the preparation of various glasses and the study of their properties. The course in ceramic calculations supplements that in glass technology and affords the student practice in the handling of mathematical problems encountered from time to time.

Some may think that the glass chemist is so specialized a being that there will be but little demand for him in the industry. The writer feels that with the training prescribed he will, with practical experience in the industry, develop into a very important factor.

As stated in the introduction the paper was presented to arouse discussion. This is earnestly invited.

*Chem. and Met. Eng., Aug. 24, 1921.
†Head, School of Chemistry, University of Pittsburgh.
[1]THE GLASS INDUSTRY, vol. 2, 1921, p. 10.
[2]Students who have had three years of German should begin French.

Move to Standardize Building Glass

Men interested in the manufacture and distribution of building glass, architects, representatives of the Bureau of Standards, Navy Department and other branches of the Government held a conference at Washington, D. C., recently, to consider ways and means of bringing about the standardization of sizes and grades of window, plate, wire, rolled, sheet and other glass. A program was outlined which is intended to result in the elimination of many unnecessary sizes and greater all-around efficiency in the utilization of glass as a building material, which is becoming more important as industrial and domestic architecture demands more light through increased window area.

The task, as outlined at the conference, included the formation of a commercially usable scientific classification of glass.

Committees were designated by the conference to gather data on and consider various phases of the window and plate glass situation.

The nomenclature in the glass industry will be studied and an effort made to define trade terms that are likely to be used with various meanings.

Another group of interested men will consider the important subject of the simplification and standardization of the sizes and qualities. Data presented at the conference showed that one jobber alone stocked more than 150 sizes of single strength window glass and nearly as many sizes of double strength window glass. It is believed that the total number of different sizes will greatly exceed this number.

Those present at the conference were: J. W. Ginder, office of the supervising architect; Sullivan W. Jones, American Institute of Architects; S. F. Voorhees, American Institute of Architects; George H. Mayer, American Window Glass Company, Pittsburgh; W. C. McCance, local manager, Pittsburgh Plate Glass Company, Baltimore; S. C. Gilmore, secretary Hires-Turner Glass Company; R. W. Spille, local manager Hires-Turner Glass Company; L. H. Forman, American Window Glass Company, Pittsburgh; R. J. Potbury, Bureau of Yards and Docks, Navy Department; F. C. Brown, N. F. Harriman, P. H. Bates, W. A. Hull and A. E. Williams of the Bureau of Standards.

Training Glassblowers

A new departure in glass factory management is to be attempted at the new works of James Powell & Sons (Whitefriars), Ltd., at Wealdstone, Middlesex, England, according to a report in *The Pottery Gazette and Glass Record*, which says:

> An important innovation is to be introduced on the ground floor, where provision is being made for spreading and tile-making kilns and for a small furnace that has been designed on the same model as the main ones, and will be used for making enamels and special colored glasses and *for instructional purposes*. This latter is an entirely new departure in the British glass industry. The altered conditions in the industry during the last 25 years have made it difficult for the company to obtain enough of the highly skilled labor essential for their manufactures, and it has been decided that the best way to enable the coming generation of glassblowers to acquire the necessary skill in the shortest time is to have a special department where each young assistant who is employed in the glasshouse shall receive, for a certain number of hours each day, special practice and instruction in glassmaking on systematic lines. It is confidently expected that by these means it will be possible quickly to produce efficient glassblowers to fill up the ranks, to enable the company to cope with the orders that they have been unable to execute, making the Wealdstone Works one of the chief centres in the country for the production of high-class domestic and scientific glassware.

Glass Products Subject to British Import Duty

Among other goods chargeable with import duty under the provisions of the "Safeguarding of Industries Act" recently passed by the British House of Commons are:

> Optical glass and optical elements, whether finished or not, microscopes, field and opera glasses, theodolites, sextants, spectroscopes and other optical instruments.
>
> Beakers, flasks, burettes, measuring cylinders, thermometers, tubing and other scientific glassware and lamp-blown ware, evaporating dishes, crucibles, combustion boats and other laboratory porcelain.
>
> Galvanometers, pyrometers, electroscopes, barometers, analytical and other precision balances, and other scientific instruments, gauges and measuring instruments of precision of the types used in engineering machine shops and viewing rooms, whether for use in such shops or rooms or not.
>
> Wireless valves and similar rectifiers and vacuum tubes.

The Public the Real Employer

There are several misconceptions of the wage question which appear persistently in everyday discussion. One is the common assumption that wages are an issue between employers and employees, with nobody else involved. Of course the public is the real paymaster, and in the last analysis the public is composed chiefly of the wage-earners themselves. Whatever they do to the public they do to themselves. The employer is simply an intermediary who plays a useful part by organizing industry and undertaking to pay a fixed wage, but unless he gets full reimbursment from the public he is soon out of business.—*Bulletin*, National City Bank, New York.

Tokyo Peace Exposition of 1922

A copy of the rules and regulations governing the Tokyo Peace Exposition of 1922 will be loaned to those interested, upon request to the Far Eastern Division of the Bureau of Foreign and Domestic Commerce, Washington, D. C. Rental for space for individual exhibits will be at the rate of 50 yen per Tsubo ($25.00 per 36 square feet) for the period of the exposition, March 10 to July 31, 1922.

Brazilian Centennial Exposition

Copies of the general rules governing the Brazilian Centennial Exposition to be held in Rio de Janeiro in 1922, may be obtained from the Bureau of Foreign and Domestic Commerce, Washington, D. C., by referring to File No. 34935.

Demand Amended Income Tax Reports

Taxpayers whose income and excess profits tax returns were figured on invested capital based on appreciated and inflated values which, according to the recent decision of the Supreme Court in the La Belle Iron Works case, is contrary to the revenue acts of 1917 and 1918, will be allowed 90 days from August 26, 1921, in which to file amended returns and pay without penalty the additional amount due the Government. Failure to do so subjects the offender to certain penalties provided for by law.

Gypsum Industries Accused of Unfair Competition

Twenty-four concerns, members of the Gypsum Industries' Association, Chicago, Ill., have been cited to answer a complaint of the Federal Trade Commission against practices alleged to be in restraint of trade, such as dividing territory and restricting sales to certain districts.

Personals

T. J. ZELLERS, president for many years of the Window Glass Cutters' and Flatteners' Protective Association, resigned recently and is reported to have become connected with the new Canadian-Libbey-Owens Sheet Glass Company, Hamilton, Ont., Canada.

OVERTON THOMPSON, district manager for Texas for the Illinois Glass Company, Alton, Ill., has resigned and returned to his home in Nashville, Tenn. B. W. CRANE, formerly of Kansas City, has been appointed successor to Mr. Thompson.

D. M. KABLE, of D. M. Kable & Company, consulting engineer and manufacturers' technical export representative, 127 N. Dearborn street, Chicago, Ill., will leave for Vancouver, B. C., and from thence sail for Japan on November 10 on the *Empress of Russia* in the interests of several machinery concerns including the O'Neill Machine Company, Toledo, O., and the Hartford-Fairmont Company, Hartford, Conn. Mr. Kable will spend part of December at Osaka, Japan, where his headquarters will be at the Osaka Hotel, and then proceed to China where, he reports, his company is supervising the erection of a large glass factory at Shanghai and will remodel two glass factories at Hong Kong. Mr. Kable reports good opportunities for the sale of glass-making equipment in the Orient.

Coming Meetings and Other Events

AMERICAN CERAMIC SOCIETY—Twenty-first annual meeting at St. Louis, Mo., February 27 to March 2, 1922.

AMERICAN GAS ASSOCIATION—Third annual convention at Congress and Auditorium hotels, Chicago, Ill., November 7 to 12, 1921.

NATIONAL GLASS DISTRIBUTORS' ASSOCIATION.—Seventh annual meeting at William Penn Hotel, Pittsburgh, Pa., December 7, 1921, at which officers and the executive committee will be elected.

THE TECHNICAL PUBLICITY ASSOCIATION of New York, the ENGINEERING ADVERTISERS' ASSOCIATION of Chicago, the ASSOCIATED BUSINESS PUBLISHERS, and other organizations interested in the proper advertising of technical products are planning to hold an industrial advertising conference when the ASSOCIATED ADVERTISING CLUBS OF THE WORLD meet in Milwaukee, in 1922.

THE NATIONAL COUNCIL LIGHTING FIXTURE MANUFACTURERS, THE DEALERS' SOCIETY OF AMERICA AND THE ILLUMINATING GLASSWARE GUILD.—Third annual lighting fixture market and second joint convention at the Auditorium, Milwaukee, Wis., January 30 to February 4, 1922. A "Better Lighting Week" will be held during the convention with demonstrations of better lighting methods for homes, office and industrial plants, also a "pageant of light" showing the progress of lighting fixtures and methods from the flaring torch to the artistic illuminating equipment of today.

News of the Trade

THE GLASS INDUSTRY will be glad to receive notices of new glass manufacturing projects, plant extensions, removals, personal items, etc.

THE CAPITOL MOLD & MACHINE WORKS, Alexandria, Va., has been organized by A. R. Bethel, formerly with the Illinois Glass Company.

THE INDIANA GLASS COMPANY is erecting a new mold shop at its plant at Dunkirk, Ind., which will be ready for occupancy shortly.

THE HAMILTON NOVELTY GLASS CO., 4801 South Maplewood Avenue, Chicago, Ill., has filed notice of change in name to the HAMILTON GLASS COMPANY.

A press report states that M. C. BROCK has developed a glass plant on a Santa Fe lease at Santa Ana, Cal., and the first product of the new plant will be lantern globes.

THE ATLANTIC BOTTLE COMPANY, at Brackenridge, Pa., is enlarging its plant which adjoins the site of the former Tarentum Glass Company and will also increase its output.

N. D. Eller, president of the LYNCHBURG GLASS WORKS, INC., Lynchburg, Va., reports that the portion of their plant which was recently destroyed by fire has been rebuilt. The loss was $10,833.

EAGLE CONVEX GLASS SPECIALTY COMPANY, Clarksburg, W. Va., has been incorporated with a capital of $50,000 by Frank Aucremanne, Edgar Terneus, C. E. Parr, Olandus West, and C. W. Leggett.

THE STAR GLASS COMPANY, Morgantown, W. Va., according to a press report, is having plans prepared for the rebuilding of its factory which was recently destroyed by fire. The new plant when completed will be valued at $225,000.

THE MYSTIC GLASS COMPANY, Los Angeles, Cal., according to a press report, has been incorporated by John V. Hoffman, Le Verne Fox and George D. Hussey, with a capital of $300,000. The company will manufacture glass products.

Lawrence E. Alley, formerly connected with the Paquet Glass Company, has opened a cut glass shop at Shinnston, W. Va., under the name of the ALLEY GLASS COMPANY. The new company will cut gas and electric light globes, tableware and novelties.

THE SAVE ELECTRIC CORPORATION, Brooklyn, N. Y., is erecting a two-story and basement factory building, 95 by 330 feet, at Toledo, Ohio. The plant will be equipped to produce 20,000 incandescent lamps daily, the total production of the Brooklyn and Toledo plants being over 40,000 lamps per day. The company also reports that they contemplate the erection of an additional plant.

THE VICTOR PRODUCTS COMPANY, 113 West Main street, Springfield, Ohio, has installed in its glass department a complete line of machinery for glass beveling. The company manufactures plate glass wind deflectors, beveled plate glass for automobiles and novelty mirrors. The officers of the company are: J. A. Cadle, president; E. E. Stanford, vice-president and L. B. Lemmon, secretary and treasurer.

JAMES YOCOM & SON, Inc., of Philadedphia Pa., old established founders and manufacturers of power transmission machinery, are now manufacturing a full line of new and improved sand blast machinery and dust arrestors for every purpose and have secured the services of H. B. Storey and A. J. Willitts, formerly manager and superintendent, respectively, for the Tilghman-Brooksbank company for a number of years.

Owens Alleges Infringement

THE OWENS BOTTLE COMPANY, Toledo, Ohio, recently acquired ownership of five Brookfield patents and during September sent notices of infringement to all known users of automatic glass-feeding devices, on the ground that claims contained in the Brookfield patents are being infringed. The company announces that its intention is to prosecute all infringers.

Macbeth-Evans Patent Case Dismissed

Judge W. H. S. Thompson, in the United States district court, at Pittsburgh, Pa., recently dismissed two patent infringement suits brought by the Macbeth-Evans Glass Company, against the L. E. Smith Glass Company, both Pennsylvania corporations. In one suit the court held that the patent was invalid for want of invention, while in the second, the opinion stated that the alleged infringement had not been established.

Inquiries Received

41. Kindly give me the names of dealers in broken glass or cullet.

42. (From France) I shall be greatly obliged if you can arrange for manufacturers to send me copies of their various catalogs and literature, particularly relating to glass working machines (bottles), furnaces, pyrometers, etc.

Foreign Trade Opportunities

Recent issues of the Daily Consular and Trade Reports issued by the Bureau of Foreign and Domestic Commerce, Washington, D. C., list the following items. Further information concerning any of them may be obtained from the Bureau or its district offices by duly registered firms and individuals, by written request giving opportunity number.

Registration in the Importers' Index entitles the registered firm to receive further information concerning items listed in the Daily Commerce Reports. Registration may be obtained by making application to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or to one of the district or cooperative offices located in nearly all of the large cities, and by filling out "form 57." Registered firms receive additional circulars and bulletins of various sorts relating to their particular line of business.

111. A gas manufacturing company in a city of Chili desires to purchase lamp shades, globes, etc. Quotations should be given c. i. f. Talcahuano. Correspondence should be in Spanish. Reference.

112. The American representatives of a mercantile firm in Australia desires to purchase and secure an agency for the sale of lamp glasses or globes, etc. Samples and prices are requested. Purchases to be paid for in cash. References.

135. A mercantile firm in Chile desires to secure an agency for the sale of glass of all kinds, especially window glass. Quotations should be given c. i. f. Talcahuano. Correspondence should be in Spanish. References.

153. A merchant in Norway desires to purchase and secure an agency for the sale of plate, window and colored printed glass. Quotations should be given f. o. b. New York. References.

174. A merchant in Sweden desires to purchase highest grade fore-pressed rough glass for cutting for such articles as bowls, vases, plates, etc. Quotations should be given f. o. b. New York. Payment, cash against documents. References.

177. A mercantile firm in Sweden desires to purchase or secure an agency for the sale of X-rays and electric lamps. Quotations should be given c. i. f. Swedish port. Cash to be paid. References.

Mexican University Plans Glass Research

That the spirit of progress is taking hold in Mexico with practical results is indicated by the recent purchase by Prof. J. Sierra, Facultad de Ciencias Quimicas, Universidad Nacional, at Tacuba, D. F., Mexico, of a No. 10 press and a No. 25 bottle blowing machine from the O'Neill Machine Company, Toledo, Ohio. This modern equipment is to be installed and used in connection with the University's studies in the technology and manufacture of glass.

American Window Glass Co. Annual Report

At the annual meeting of the stockholders of the American Window Glass Machine Company held at the company's office in the Farmers Bank Building, Pittsburgh, Pa., on October 18th, W. L. Munro, president, submitted a report and financial statement for the fiscal year ending August 26, 1921.

The reports cover operation, production and also improvements made at the company's plants at Arnold, Pa., Jeannette, Pa., Hartford City, Ind., and Monongahela, Pa. Mention was also made of license agreement entered into with the Interstate Window Glass Company for the use of a number of their machines. A satisfactory settlement has been made with the Libbey-Owens Sheet Glass Company and the Toledo Glass Company of a patent litigation which the American Company contemplated bringing against the two companies for the infringement of certain of their patents. The president also reported that in the suit brought by the Pittsburgh Plate Glass Company against the Company for infringement of the Spinasse cold bait patent, the United States court of Appeals affirmed the decision of Judge Thomson, of the United States District Court in their favor, but that the suit brought by the Pittsburgh Window Glass Co., covering the Raspillaire cold bait patent, was decided against them.

GENERAL BALANCE SHEET, AUGUST 26, 1921.

ASSETS.

Cash, notes and accounts receivable	$2,627,285.63
United States Liberty Bonds and Treasury Certificates	762,600.00
Finished product, materials and supplies	3,230,045.14
Freight, taxes and insurance paid in advance	67,553.68
Plants, real estate and good will	21,786,775.57
Investments	70,686.61
Treasury stock	5,000.00
Deferred charges—Discount on bonds, etc	19,380.41
Total	$28,569,327.04

LIABILITIES.

Accounts payable for materials, wages, etc	$273,026.46
Preferred stock dividend, payable September 1, 1921	140,000.00
Royalty payable	130,302.53
Reserved for taxes	980,411.95
First mortgage and collateral trust 6 per cent sinking fund gold bonds, due February 1, 1922	245,000.00
Reserve for depreciation of plants and equipment and doubtful accounts and notes receivable	2,474,538.79
Preferred capital stock	4,000,000.00
Common capital stock	13,000,000.00
Profit and loss surplus	7,326,047.31
Total	$28,569,327.04

Summary of income, profit and loss, for period ended August 26, 1921—

Net profit from operations		$1,955,414.20
Other income		649,957.77
Total income		$2,605,371.97
Deductions from income—		
Reserved for Federal taxes	$98,353.64	
Royalty	1,353,659.61	
Other charges	376,381.63	
		1,823,394.88
Surplus for year		$776,977.09
Surplus August 27, 1920		6,974,800.22
Total surplus		$7,751,777.31
Deductions from surplus—		
Dividends on preferred stock	$279,650.00	
Charges applicable to prior year's operations	146,080.00	
		425,730.00
Surplus August 26, 1921		$7,326,047.31

New Publications

ANALYSIS AND TESTING OF IMPURITIES IN CAUSTIC SODA. Technical Bulletin No. 7 issued by the Solvay Process Company, Syracuse, N. Y. This bulletin contains methods compiled from standard authorities, with modifications made by the company's laboratory, and used by them with satisfactory results.

The first number of THE OWENS QUARTERLY, a house organ published by the Owen Bottle Company, Toledo, Ohio, has appeared. The purpose of the new publication, as announced, is to make the company's stockholders better acquainted with conditions in the glass container industry and to supply them at regular periods with financial reports and general news relating to the company.

ERECTING AND OPERATING INSTRUCTIONS FOR GAS PRODUCERS.—Chapman Engineering Company, Mt. Vernon, Ohio. This 20-page booklet contains detailed instructions for successfully operating bituminous gas producers. It also contains numerous diagrams. The company announces that the work is entirely original and that the information is based on twenty years of experience in developing, manufacturing and operating gas producers. Copies of the booklet will be sent upon request to all concerns interested in this important subject.

ELECTRIC FURNACES—Catalog 9-C, 1921-1922. Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. A handsome 24-page publication devoted to Westinghouse industrial furnaces. The types illustrated and described are principally for heat treating operations and include furnaces specifically adapted for annealing glass tableware, reflectors, lamp bulbs, window and plate glass, bottles and chemical and ornamental glassware.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of THE GLASS INDUSTRY, published monthly, at New York, N. Y., for October 1, 1921.

State of New York } ss.
County of New York }

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared G. W. Cooper, who, having been duly sworn according to law, deposes and says that he is the managing editor of THE GLASS INDUSTRY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Glass Industry Publishing Company, Inc., 19 Liberty St., New York; editor, J. B. Krak, 19 Liberty St., New York; managing editor, G. W. Cooper, 19 Liberty St., New York; business manager, G. W. Cooper, 19 Liberty St., New York.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent. or more of the total amount of stock) Glass Industry Publishing Company, Inc.; L. J. Krom, 1205 Fairmont Ave., Fairmont, W. Va.; G. W. Cooper, 19 Liberty St., New York; F. B. Krom, 28 Nassau St., New York.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

G. W. COOPER.

Sworn to and subscribed before me this 26th day of September, 1921.

[Seal] O. B. LEWIS.

(My commission expires March 30, 1922.)

Monthly Summary of Foreign Commerce of the United States in Glass

Corrected to September 17, 1921.

IMPORTS OF GLASS AND GLASSWARE

	August 1920 Quantity	August 1920 Value	August 1921 Quantity	August 1921 Value	Eight months ending August 1919 Quantity	1919 Value	1920 Quantity	1920 Value	1921 Quantity	1921 Value
Glass and glassware:										
Bottles, vials, carboys, etc., plain, empty or filled ....lbs. dut.	1,260,112	$57,713	1,191,328	$44,876	800,083	$43,106	3,804,182	$177,080	5,234,771	$232,485
Bottles, decanters, and other glassware, cut or ornamented....dut.	.....	137,761	.....	118,665	.....	244,751	.....	578,140	.....	942,039
Optical instruments, including lenses and spectacles .....dut.	.....	126,291	.....	73,542	.....	159,461	.....	546,637	.....	701,074
Sheet and plate glass—										
Cylinder, crown, and common window glass, unpolished .....lbs. dut.	588,518	65,813	3,927,578	209,447	502,649	50,368	3,651,422	371,370	34,441,152	1,962,813
Plate glass, cast, polished, unsilvered .....sq. ft. dut.	245,902	213,799	124,208	74,827	.....	.....	1,069,700	877,981	1,661,477	1,262,867
Plates or disks, rough-cut, for optical purposes .....lbs. free	94,332	117,448	10,840	16,038	379,659	266,725	699,665	658,193	559,041	504,672
All other .....dut.	.....	287,435	.....	266,070	.....	362,865	.....	1,136,435	.....	1,719,765
Total	.....	$1,006,260	.....	$803,465	.....	$1,136,276	.....	$4,345,836	.....	$7,325,715

EXPORTS OF GLASS AND GLASSWARE

Glass and glassware:										
Bottles, demijohns, carboys, and jars.....	.....	$721,542	.....	$319,213	.....	$3,243,669	.....	$6,435,919	.....	$3,801,419
Chemical glassware	.....	16,937	.....	8,783	.....	130,323	.....	147,647	.....	170,832
Common window glass, boxes (50 sq. ft.)	46,147	329,540	483	3,058	668,108	4,617,079	400,155	2,750,621	51,856	413,806
Exported to—										
Canada	29,049	199,072	28	243	83,859	458,796	202,764	1,276,500	6,837	52,289
Mexico	4,940	33,543	176	1,425	17,798	129,477	17,639	149,193	17,198	143,567
Cuba	2,313	15,232	.....	.....	10,873	82,931	25,720	177,988	5,826	52,722
Argentina	1,072	7,606	.....	.....	78,820	548,986	13,877	114,819	2,440	17,205
Brazil	1,760	13,055	.....	.....	50,579	319,007	23,217	167,919	2,128	12,191
Chile	.....	.....	.....	.....	23,523	159,795	10,835	64,954	168	1,791
Uruguay	2,080	11,906	.....	.....	.....	.....	4,065	26,404	2,318	14,077
China	.....	.....	.....	.....	.....	.....	22,334	150,180	1,190	11,822
Japan	500	9,742	.....	.....	5,123	59,507	15,839	144,455	70	944
Australia	752	6,139	.....	.....	95,094	573,320	9,737	75,732	1,648	12,423
New Zealand	200	2,703	.....	.....	23,620	131,603	3,055	23,630	8	54
Other countries	3,481	30,542	279	1,390	278,809	2,153,657	51,073	378,847	12,025	94,721
Cut or engraved glassware.....	.....	31,233	.....	6,040	.....	153,458	.....	266,552	.....	135,969
Plate glass, unsilvered.....sq. ft.	232,556	165,915	140,040	58,548	6,037,074	3,474,219	3,050,530	1,934,861	1,697,699	1,048,954
All other	.....	844,346	.....	332,403	.....	5,312,003	.....	7,540,239	.....	5,981,949
Total glass, etc.....	.....	$2,109,513	.....	$728,045	.....	$16,930,751	.....	$19,075,839	.....	$11,552,929

Current Prices of Glass-Making Materials

From quotations furnished by various manufacturers and dealers

October 24, 1921

	Carlots	Less Carlots
Alumina hydrate .....lb.	.05½	.06
Arsenic trioxide (dense white, 99%) .....lb.	.06½	
Barium carbonate .....ton	52.00	60.00
Bone ash .....lb.	.04	.04½
Borax .....lb.	.05¼–.05½	.05½–.06
Borax, fused, and mesh.....lb.	.19	.20
Boric acid, fused .....lb.	.35	.35
Cadmium sulphide, red or orange .....lb.		1.60
Cadmium sulphide, yellow...lb.		2.00
Cobalt oxide .....bbls. lb.		2.00
Cobalt oxide .....10 lb. tins, lb.		2.10
Copper oxide, red.....lb.		.17– .20
Copper oxide, black.....lb.	.23	.26
Copper oxide, black, prep'ed, lb.		.30
Cryolite .....lb.		.10
Feldspar, 100 mesh.....ton	18.00	
Fluorspar, powdered white, 90% .....ton	38.00	
Kaolin .....ton	17.00	25.00
Lead oxide (red lead, Pb_3O_4) lb.	.08	.08¼
Litharge (PbO) .....lb.	.07½	.07¾
Lime—		
Hydrated .....ton	45.00	
Burnt, ground, in bulk.....ton	7.50	
Burnt, ground, in paper sacks .....ton	9.50	
Burnt, ground, in 280 lb. bbls per bbl.		2.05
Manganese (85% MnO_2) ....lb.	.03½	.04 –.06½
Nickelic oxide (NiO) black..lb.		.43 –.50
Nickelous oxide (Ni_2O) green lb.		.42 –.50
Potassium carbonate—		
Calcined 90% .....lb.	.05½	.06½
Hydrated 90% .....lb.	.06	.07
Potassium nitrate .....lb.	.09½	.09¾
Powdered blue .....lb.		.24–.26
Powdered blue (std. formula) lb.		.45
Salt cake, for glassmakers...ton	21.00	.01½–.02 lb.
Selenium .....lb.		1.95–2.25
Soda ash, 58% dense, 48% basis Bulk .....100 lb.	1.50	1.55
Bulk, on contract.....100 lb.	1.50	
Sodium nitrate, refined.....lb.	.06	.07½
Sodium selenite .....lb.		2.25
Sulphur (flowers) .....lb.	.02¼	.02¾
Sulphur (flour, heavy).....lb.	.02	.02¼
Uranium oxide....100 lb. lots, per lb.		2.10–2.25
Zinc oxide (ZnO) .....lb.	.07½–.11	.08–.11¼

Stock Quotations

(Reported by Moore, Leonard & Lynch, Frick Building, Pittsburgh, Pa.)

Pittsburgh Stock Exchange—October 26

	Bid	Ask	Last
American Window Glass Machine Com.	65	68	67
American Window Glass Machine Pfd.	74	75½	75½
American Window Glass Pfd.....	—	95	95
Pittsburgh Plate Glass	116	120	118
U. S. Glass	35	—	40

Market dull with prices firm. Companies all operating but on reduced scale.

Wheeling Stock Exchange—October 26

Fostoria Glass Company	110	116	110
Hazel Atlas Glass Co.....	138	140	140
Imperial Glass Co.	90	100	100
Central Glass Company	—	154	155

Market firm on all issues excepting pronounced weakness in Hazel-Atlas which lost about 10 points. Weakness due to failure of directors to restore 2% quarterly dividend. Directors declared 1% cash dividend. Local plants running about 75% of normal.

Toledo Stock Exchange—October 26

Libbey Owens Sheet Glass Com.....	105	110	107
Libbey Owens Sheet Glass Pfd.....	98	99	98
Owens Bottle Machine Co. Com.....	27	29	28
Owens Bottle Machine Co. Pfd.....	96	97½	97

Market firm.